ARC TYPE 15E

VHF Navigation Equipment

Aircraft Radio Corporation
Boonton, New Jersey

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WARRANTY

Aircraft Radio Corporation (ARC) warrants each item of new equipment manufactured by it to be free from defects in material and workmanship under normal service use for which intended. ARC obligates itself under this warranty to replace or repair (at ARC discretion), at its factory, any ARC equipment, or major unit thereof (excluding vacuum tubes and transistors), which shall within one year after delivery to the original purchaser thereof be returned, transportation charges prepaid, to ARC with a statement from an authorized ARC Distributor or Dealer establishing the date of such delivery, which ARC examination shall disclose to have been defective in manufacture. This warranty shall not apply to any equipment, or major unit thereof, which, in the judgment of ARC, has been repaired or altered in any way so as adversely to affect its performance or reliability, or which has been subject to misuse, negligence or accident. This warranty is in lieu of all other guaranties or warranties express or implied. The obligation and responsibility of ARC for or with respect to defective equipment shall be limited to that expressly provided herein and ARC shall not be liable for consequential or other damage or expense whatsoever therefor or by reason thereof.

ARC reserves the right to make changes in design or additions to or improvements in its equipment without obligation to install such additions or improvements in equipment theretofore manufactured.

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SECTION I
GENERAL INFORMATION

1–1. PURPOSE.

The ARC Type 15E VHF Navigational Receiving Equipment is an airborne radio receiving set, with a frequency range of 108 to 135 mc, designed to receive the following vhf radio airways facilities: vhf omnidirectional ranges (VOR), visual-aural ranges (VAR), and localizers. In addition, the equipment can operate as the receiver section of a vhf transmitter-receiver system when used with an ARC transmitter designed for that purpose.

1–2. UNITS AND ACCESSORIES SUPPLIED.

The units and accessories of the Type 15E are listed in Table 1–1 and are shown in Figure 1–1.

Note

The ARC Type IN-14 Course Indicator, listed in Table 1–1 and described briefly in paragraph 1–4, is substituted for the ARC Type IN-10 Course Indicator when the Type 15E is used in association with the ARC Type CD-1 or Type CD-2 Course Director. Though only the IN-10 is referenced in this instruction book, the information given pertains also to the IN-14, unless noted otherwise.

1–3. UNITS REQUIRED BUT NOT SUPPLIED.

Cable assemblies, and in some instances completed mechanical linkage assemblies, required for interconnecting the components of the Type 15E, are not supplied. The cable assemblies are fabricated from individual wires, which are not furnished, and from the supplied connectors and coaxial cable listed in Table 1–1. The wire size and the connectors for interconnecting cables, in either one- or two-rack installations (Figures 2–11 through 2–14), will vary with the type of components installed. The actual length of the cables and the mechanical linkage will depend on the location of the equipment in the aircraft.

1–4. DESCRIPTION OF UNITS.

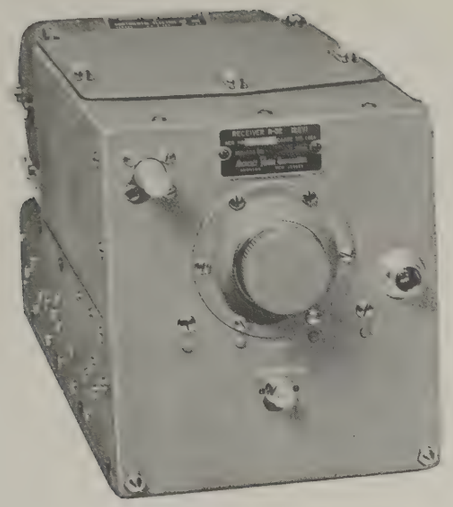
Antenna. The ARC Type A-13B Antenna is the receiving antenna for the Type 15E. It is a "rams horn" type with two dipole antennas. The forward dipole is used for glide slope signal reception, if such equipment is installed in the aircraft. The V-shaped rear dipole is used for reception of all other signals. Both antennas terminate in individual UG-291/U coaxial connectors located in the antenna base. The dipoles are set in a rubber block, which in turn is fastened to an aluminum pedestal support. The A-13B is designed for mounting on any relatively flat portion of the aircraft structure. The pedestal support has two 1/16-inch radius drainage tunnels at its base that permit the escape of accumulated moisture when the A-13B is mounted in an upright position. When the A-13B is mounted in an inverted position, it is necessary to drill through the white-marked, 5/32-inch diameter depression in the top of the rubber block to provide for moisture drainage.

Caution

Take care to drill only through the rubber. The antenna will be damaged if the drill penetrates too deeply.

Antenna Coupler. The ARC Type A-17 Antenna Coupler is a network designed to permit the coupling of a VOR dipole antenna into a nominal 50-ohm coaxial cable. It is intended for use with dipole antennas which are part of the aircraft. The circuit is installed on a mounting base and is enclosed by a screw-attached cover. Two post-type terminals for connecting the dipole rods extend out through the cover. A UG-290A/U coaxial connector is provided for connecting the A-17 (through RG-58/U coaxial cable terminated with UG-88C/U connectors) to the ARC Type R-32 Receiver.

Receiver. The ARC Type R-32 Receiver is a nine-tube superheterodyne receiver continuously tunable between 108 and 135 mc. It provides an aural output for headset operation and a navigation output to other units of the Type 15E. The R-32 includes no local tuning controls but is designed to be tuned remotely by a control unit such as the ARC Type C-1254A Control Unit or by a custom built unit. A squelch control, an antenna input connector, a mechanical linkage connection to the tuning capacitor drive gear, and an auxiliary equipment power supply connector are located on the front panel of the R-32 Receiver. The squelch control is a screwdriver adjustment used to set the operating level of the squelch under operating conditions. The auxiliary equipment power supply connector, normally covered by a cap, is used for connecting the receiver's high-voltage supply to a vhf transmitter or to a 75-mc marker beacon receiver. A wired plug, located behind the cap, is connected to this



RECEIVER R-32
WITH
DYNAMOTOR D-10A

INDICATOR IN-10

CONVERTER B-13A

CONNECTOR
ARC-14320

CONNECTOR
ARC-14491

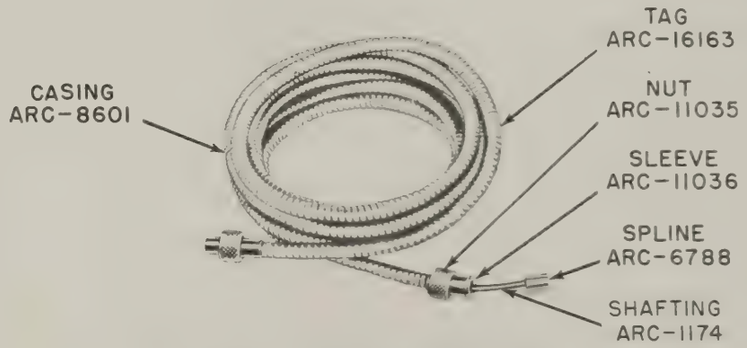
CONNECTOR
ARC-14050

CONNECTOR
ARC-15911

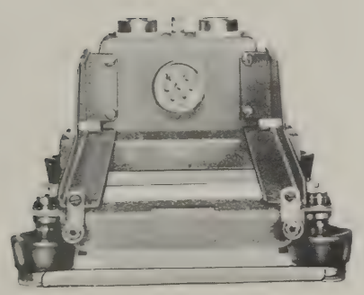
CONNECTOR
ARC-15912

CONNECTOR
ARC-16210

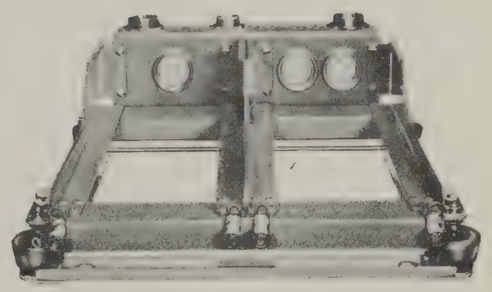
CONNECTOR
ARC-11337



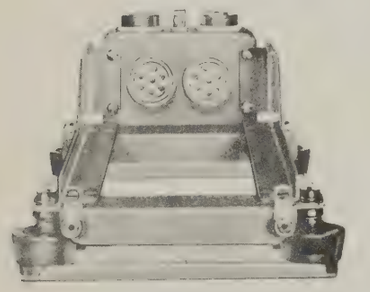
MECHANICAL LINKAGE ARC-16158



RACK E-18
ON
MOUNTING M-25

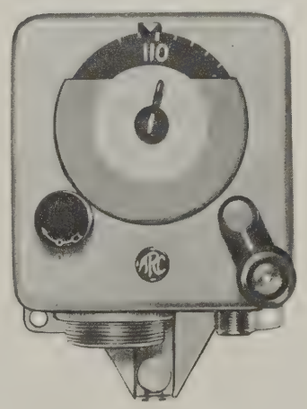


RACK E-17
ON
MOUNTING M-10

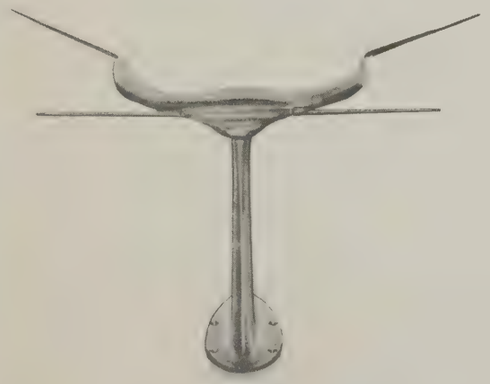


RACK E-16
ON
MOUNTING M-25

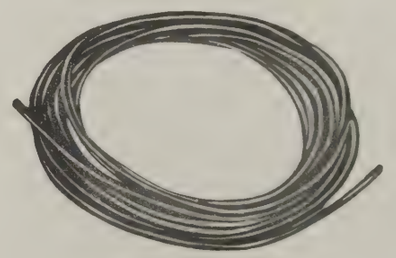
CONTROL UNIT C-1254A



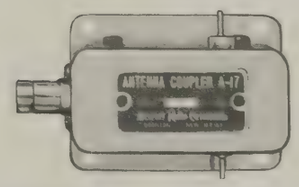
CONTROL UNIT C-22A
ON
MOUNTING M-18



ANTENNA A-13B



CABLE
ARC-11318



ANTENNA COUPLER A-17

TP1228

Figure 1-1. ARC Type 15E Equipment, Major Units and Accessories

SECTION I
GENERAL INFORMATION

1–1. PURPOSE.

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1–2. UNITS AND ACCESSORIES SUPPLIED.

The units and accessories of the Type 15E are listed in Table 1–1 and are shown in Figure 1–1.

Note

The ARC Type IN-14 Course Indicator, listed in Table 1–1 and described briefly in paragraph 1–4, is substituted for the ARC Type IN-10 Course Indicator when the Type 15E is used in association with the ARC Type CD-1 or Type CD-2 Course Director. Though only the IN-10 is referenced in this instruction book, the information given pertains also to the IN-14, unless noted otherwise.

1–3. UNITS REQUIRED BUT NOT SUPPLIED.

Cable assemblies, and in some instances completed mechanical linkage assemblies, required for interconnecting the components of the Type 15E, are not supplied. The cable assemblies are fabricated from individual wires, which are not furnished, and from the supplied connectors and coaxial cable listed in Table 1–1. The wire size and the connectors for interconnecting cables, in either one- or two-rack installations (Figures 2–11 through 2–14), will vary with the type of components installed. The actual length of the cables and the mechanical linkage will depend on the location of the equipment in the aircraft.

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Caution

Take care to drill only through the rubber. The antenna will be damaged if the drill penetrates too deeply.

Antenna Coupler. The ARC Type A-17 Antenna Coupler is a network designed to permit the coupling of a VOR dipole antenna into a nominal 50-ohm coaxial cable. It is intended for use with dipole antennas which are part of the aircraft. The circuit is installed on a mounting base and is enclosed by a screw-attached cover. Two post-type terminals for connecting the dipole rods extend out through the cover. A UG-290A/U coaxial connector is provided for connecting the A-17 (through RG-58/U coaxial cable terminated with UG-88C/U connectors) to the ARC Type R-32 Receiver.

Receiver. The ARC Type R-32 Receiver is a nine-tube superheterodyne receiver continuously tunable between 108 and 135 mc. It provides an aural output for headset operation and a navigation output to other units of the Type 15E. The R-32 includes no local tuning controls but is designed to be tuned remotely by a control unit such as the ARC Type C-1254A Control Unit or by a custom built unit. A squelch control, an antenna input connector, a mechanical linkage connection to the tuning capacitor drive gear, and an auxiliary equipment power supply connector are located on the front panel of the R-32 Receiver. The squelch control is a screwdriver adjustment used to set the operating level of the squelch under operating conditions. The auxiliary equipment power supply connector, normally covered by a cap, is used for connecting the receiver's high-voltage supply to a vhf transmitter or to a 75-mc marker beacon receiver. A wired plug, located behind the cap, is connected to this

TABLE 1–1. UNITS AND ACCESSORIES

Quantity		Name	ARC Type No.	ARC Part No.
With E-17 Rack	With E-16 & E-18 Racks			
		UNITS		
1	1	Antenna	A-13B[1]	15823
1	1	Antenna Coupler	A-17[1]	17300
1	1	Converter	B-13A[2]	16830(*)
1	1	Control Unit	C-22A[3]	15601
1	1	Control Unit	C-1254[2, 3]	16230(*)
1	1	Control Unit	C-1254A[2, 3]	21130(*)
1	1	Course Indicator	IN-10[4]	16706
1	1	Course Indicator	IN-14[4]	18028
1	1	Dynamotor	D-10A(14V)[5]	14401
1	1	Dynamotor	D-10A(28V)[5]	14402
1	1	Dynaverter®	DV-10A[5]	19840
1	1	Dynaverter®	DV-11A[5]	21100
1	—	Mounting	M-10	12901
1	1	Mounting	M-18[3]	12705
—	2	Mounting	M-25	16780
—	1	Rack	E-16	16770
1	—	Rack	E-17[2]	19800(*)
—	1	Rack	E-18[2]	21190(*)
1	1	Receiver	R-32[2]	19810(*)
		ACCESSORIES		
1	1	Cable, coaxial	—	11318(20 ft)
2	4	Connector, coaxial	—	11337
2	2	Connector, plug	—	14050
1	1	Connector, plug	—	14320
1	—	Connector, plug	—	14491
—	1	Connector, plug	—	15911
1	2	Connector, plug	—	15912
1	1	Mechanical Linkage	—	16158(10 ft)

[1] A-13B Antenna is normally supplied for use on all aircraft except jet aircraft. In jet aircraft, the A-17 Antenna Coupler is installed inside canopy with two ⅛-inch diameter rods (not supplied), each about 25 inches long, forming the dipole. The A-17 may also be used to match a dipole antenna mounted on the vertical fin to a standard 50-ohm coaxial cable.

[2] B-13A Converter, C-1254 and C-1254A Control Units, E-17 Rack, E-18 Rack, and R-32 Receiver are supplied for either 14- or 28-volt dc operation, as specified. Voltage is indicated in place of asterisk for complete part number.

[3] C-22A, C-1254, and C-1254A Control Units are alternatives. The M-18 Mounting is required for the C-22A only. Whistle-through tuning of the R-32 Receiver is possible only with the C-1254A or when proper components are selected for custom built control panels.

[4] IN-14 Course Indicator is used instead of IN-10 Course Indicator when the Type 15E is used with ARC Type CD-1 or CD-2 Course Director.

[5] D-10A Dynamotors and DV-10A or DV-11A Dynaverters® are alternatives. The DV-10A is a 28-volt dc model; the DV-11A is a 14-volt dc model.

connector to complete the receiver's high-voltage circuit when no auxiliary equipment is connected.

Caution

Unless auxiliary equipment is connected, the wired plug must be left in place to insure operation of the Type 15E.

Four vibration mounts and an input connector for the ARC Type D-10A Dynamotor, DV-10A Dynaverter®, or DV-11A Dynaverter® are located at the rear of the receiver chassis. An output connector is located at the rear of the receiver chassis and plugs into the mating connector on the ARC Type E-17 or ARC Type E-18 Rack. A snapslide-attached cover on top of the receiver chassis permits access to all electron tubes and alignment points.

Converter. The ARC Type B-13A Converter is a five-tube unit designed to accept the VOR, VAR, and localizer information delivered by the R-32 Receiver and convert it to a form that is presented visually by the instrumentation provided. The B-13A includes no operating or tuning controls. Input and output connectors are located at the rear of the chassis and mate with the connectors on the ARC Type E-16 or ARC Type E-17

Rack. All electron tubes are accessible with the removal of the top cover. Three alignment controls are located behind a snapslide-attached cover on the front panel; however, they are not required for any operating procedure and must not be tampered with.

Racks. The ARC Type E-17 Rack is designed to support both the R-32 Receiver and the B-13A Converter. The ARC Type E-18 Rack and the ARC Type E-16 Rack are one-unit mounting racks designed to support the R-32 and B-13A, respectively. The racks also serve as the terminal junction box for all units of the Type 15E. When the E-17 is used, the R-32 and B-13A are installed in individual stalls and secured by means of nut-and-link arrangements that engage the conical studs located on the front of the units. The E-16 and E-18 are used where space limitations prevent the use of the E-17 Rack, or where it is desirable to locate one unit remotely from the other (there is no practical limit to the allowable separation between units under this condition). In all racks, the component parts are contained in an enclosure at the rear of the rack. The circuit of the E-17 is duplicated in the E-16 and E-18.

Indicator. The ARC Type IN-10 Course Indicator is a combined cross-pointer meter and course selector/to-from instrument. Functionally, it combines the purposes of the individual ARC-13310 Cross-Pointer Meter and the ARC-15463 Course Selector/To-From Meter in a single instrument. The cross-pointer-meter section of the IN-10 is a special type of microammeter with two pointer mechanisms, and two flag alarm mechanisms for indicating the operating or non-operating condition of the pointer mechanisms.

The vertical pointer visually indicates the VOR, VAR, or localizer information received from the B-13A Converter circuits. It is pivoted at the top and moves left or right to supply a visual indication of the lateral position of the aircraft with respect to the on-course signal of the VOR, VAR, or localizer. The horizontal pointer is pivoted at the left and moves up and down. This pointer is used with a glide slope receiver to show the relation of the aircraft to the glide slope when such equipment is installed in the aircraft. Fluorescent blue and yellow sectors are included for flying the visual courses of VAR and localizers. A red flag alarm is associated with each pointer. The vertical pointer flag alarm and the to-from meter indication serve to indicate the presence or absence of proper output signals from the B-13A Converter.

The course selector portion of the IN-10 permits the selection of any desired track to or from a VOR station, or indicates the magnetic bearing of the aircraft from a VOR station. The course selector dial is graduated in a compass scale of 360°. A triangle-shaped pointer is used for the course indication and a ball as the reciprocal indication on the course indicator scale. The to-from meter is a zero-center d-c instrument that provides the sense information required to resolve any ambiguity in the reading of the course indicator dial. The meter will show TO when the indicated bearing on the course indicator dial is the magnetic bearing *to* the station. It will show FROM when the indicated bearing on the course indicator dial is the magnetic bearing *from* the station. When reading the to-from meter, the vertical pointer should be approximately centered. When neither TO nor FROM is indicated, it may be that the indication is passing through the neutral point on the way from one indication to the other; or the received signal may be too weak to be reliable; or the received signal may not be a proper signal.

Alternative Indicator. The ARC Type IN-14 Course Indicator is used instead of the ARC Type IN-10 Course Indicator when the Type 15E is operated with the ARC Type CD-1 or Type CD-2 Course Director. The IN-14 is similar in function and design to the IN-10; however, besides performing the functions of the IN-10, the IN-14 provides the computer unit of the Type CD-1 or Type CD-2 with information regarding the magnetic bearing of the desired track. For further details, refer to the instruction book for the ARC Type CD-1 or Type CD-2 Course Director.

Control Unit. The ARC Type C-1254A Control Unit provides:

1. Remote power control of the Type 15E
2. Remote tuning control of the R-32 Receiver
3. Volume control of the audio output
4. Switch control for selecting VOR or VAR and localizer signals
5. Whistle-through tuning of the R-32 Receiver when operated with an ARC transmitter.

Power and volume control is controlled by an off-on rotary switch combined with a variable resistor. Remote tuning of the R-32 Receiver is made possible by the interconnection of mechanical linkage between the R-32 and the C-1254A. The mechanical linkage is geared to a tuning crank and a frequency-indicating dial on the control unit. The desired type of signal reception is selected by means of a single-pole, single-throw toggle switch. Whistle-through tuning of the R-32 is accomplished when the tuning crank is depressed to actuate a switch in the control unit, which completes the whistle-through circuits.

Edge-lighting illumination of the C-1254A is provided by three midget flange-base lamps installed in red-filter light assemblies located on the front panel. Power to these lamps is brought in through a separate wire and is controlled by the aircraft's electrical system panel-light

control. The light is transmitted through a plastic panel that has a dull black finish, except for index lines and control designations which are translucent white, and the areas behind the frequency-indicating dial and VOL knob which are clear, sandblasted sections. All operating controls are located on the front panel.

Alternative Control Units. The ARC Type C-22A Control Unit and ARC Type C-1254 Control Unit are alternative control units that can be used with the Type 15E. The C-22A is used in aircraft where only bulkhead or panel mounting is available. The C-1254 is an edge-lighted unit similar to the C-1254A. Whistle-through tuning of the R-32 Receiver is not possible with either the C-22A or C-1254.

Dynamotor. The ARC Type D-10A Dynamotor furnishes high voltage to the R-32 Receiver and the B-13A Converter. The D-10A plugs into a mating connector at the rear of the receiver chassis and is secured to four vibration mounts on the receiver chassis by snapslides located on the base of the D-10A. The 28-volt model of the D-10A has a rated input of 1.7 amperes at 27.5 volts dc and a rated output of 85 ma at 250 volts dc; the 14-volt model has a rated input of 3.4 amperes at 13.75 volts dc with the same output.

Dynaverter®. The ARC Type DV-10A Dynaverter® and ARC Type DV-11A Dynaverter® are transistorized power supplies that may be used in place of the D-10A Dynamotor to supply high voltage to the R-32 Receiver and B-13A Converter. The Dynaverter is mounted in the same position on the receiver chassis as the dynamotor. The DV-10A has a rated input of 1.22 amperes at 26 volts dc and the DV-11A has a rated input of 2.6 amperes at 12 volts dc (values are nominal). Both dynaverters have a maximum rated output of 200 ma at 260 volts dc.

Mountings. The ARC Type M-10 Mounting is provided to support the E-17 Rack. The ARC Type M-25 Mounting is used to support the E-16 Rack or E-18 Rack. Vibration mounts are used at each corner of the mountings and the racks are secured to their respective mountings by means of four snapslides engaging the grooved studs of the vibration mounts. Two ground straps fastened from the two rear vibration mounts to the channel frame ground the mounting to minimize r-f noise. Eight holes in the M-10 channel frames and four holes in the M-25 channel frames are provided for securing the mountings, with the attaching hardware parts also serving to ground the mounted components.

The ARC Type M-18 Mounting is a plate-type mounting provided for the C-22A Control Unit. A disc-type spring is riveted to the plate for mounting tension. Four holes are provided for attaching the mounting to a bulkhead or panel.

Accessories. The accessories supplied as part of the Type 15E include all parts except the individual wires required for the interconnecting cable assemblies.

1–5. POWER REQUIREMENTS.

The ARC Type 15E Equipment requires a primary power source capable of supplying 2.9 amperes at 28 volts dc or 5.8 amperes at 14 volts dc.

1–6. CAA TYPE CERTIFICATION.

The R-32 Receiver and B-13A Converter are CAA type certificated as follows:

Unit	*CAA Type Certificate No.*
R-32 Receiver	1454
B-13A Converter	IR4-7

1–7. WEIGHTS.

The weights of the Type 15E units are listed in Table 1–2. Their dimensions are detailed in Figures 2–1 through 2–10.

TABLE 1–2. WEIGHTS

Unit	*Weight (Pounds)*
A-13B Antenna	3.6
A-17 Antenna Coupler	0.1
B-13A Converter	5.8
C-22A Control Unit	0.7
C-1254 Control Unit	0.8
C-1254A Control Unit	0.8
D-10A Dynamotor	2.9
DV-10A Dynaverter®	1.7
DV-11A Dynaverter®	1.6
E-16 Rack	1.3
E-17 Rack	2.3
E-18 Rack	1.3
IN-10 Course Indicator	3.3
IN-14 Course Indicator	3.4
M-10 Mounting	0.7
M-18 Mounting	0.3
M-25 Mounting	0.8
R-32 Receiver	5.7

SECTION II
INSTALLATION AND ADJUSTMENT

2–1. PREPARATION FOR USE.

Except for the fabrication of the interconnecting cable assemblies and mechanical linkage, no special procedures are required before installation to prepare the Type 15E for use. If desired, a bench test check-out of the equipment may be made before installation in the aircraft. For this purpose, a signal source similar to the ARC Type H-14A Signal Generator is required.

2–2. INSTALLATION CONSIDERATIONS.

The location and installation of the Type 15E will depend on the type of aircraft in which the equipment is to be installed. Unit outline dimensions are shown in Figures 2–1 through 2–10. Intercabling diagrams for one-rack and two-rack installations are shown in Figures 2–11 and 2–12. To avoid errors and facilitate installation, and to obtain maximum efficiency and ease of operation of the equipment, consideration should be given to the following points when planning the installation.

1. Compare the installation area under consideration with the dimensions noted on the applicable illustration (Figures 2–1 through 2–10).

2. Locate the units so that they are accessible for inspection and maintenance, and in an area that is free of excessive vibration or heat.

3. The ARC Type C-1254, C-1254A, or C-22A Control Unit and the ARC Type IN-10 Course Indicator must be located at the operator's position with the indicator installed on the aircraft's shock-mounted instrument panel.

4. The coaxial cable from the antenna to the receiver should be kept as short as possible.

5. The ARC Type R-32 Receiver should be reasonably close to the control unit to avoid the use of an excessive length of mechanical linkage.

6. Units should be installed so that they are approximately horizontal when the aircraft is in level flight.

7. Allow sufficient clearance on all sides of each unit for sway, ventilation, and easy removal.

8. Leave sufficient space at the rear of the ARC Type E-17 Rack, or the E-16 and E-18 Racks, to permit cable connections to be made. Also, arrange and size the cabling so as not to restrict shock-mount travel.

9. Do not run cables where they may be subjected to excessively high temperatures, such as may exist adjacent to heaters or engine exhausts.

10. Do not make sharp bends in any cable.

2–3. INSTALLATION OF ANTENNA.

The location and installation of the ARC Type A-13B Antenna will depend on the aircraft in which the equipment is installed. As the final position of the antenna can affect the overall performance of the Type 15E, observe the following recommendations:

1. Locate the antenna, if possible, at a point where clear line-of-sight area is available.

2. If possible, keep the antenna symmetrical with the centerline of the aircraft.

3. Install the antenna with the glide slope antenna section facing forward.

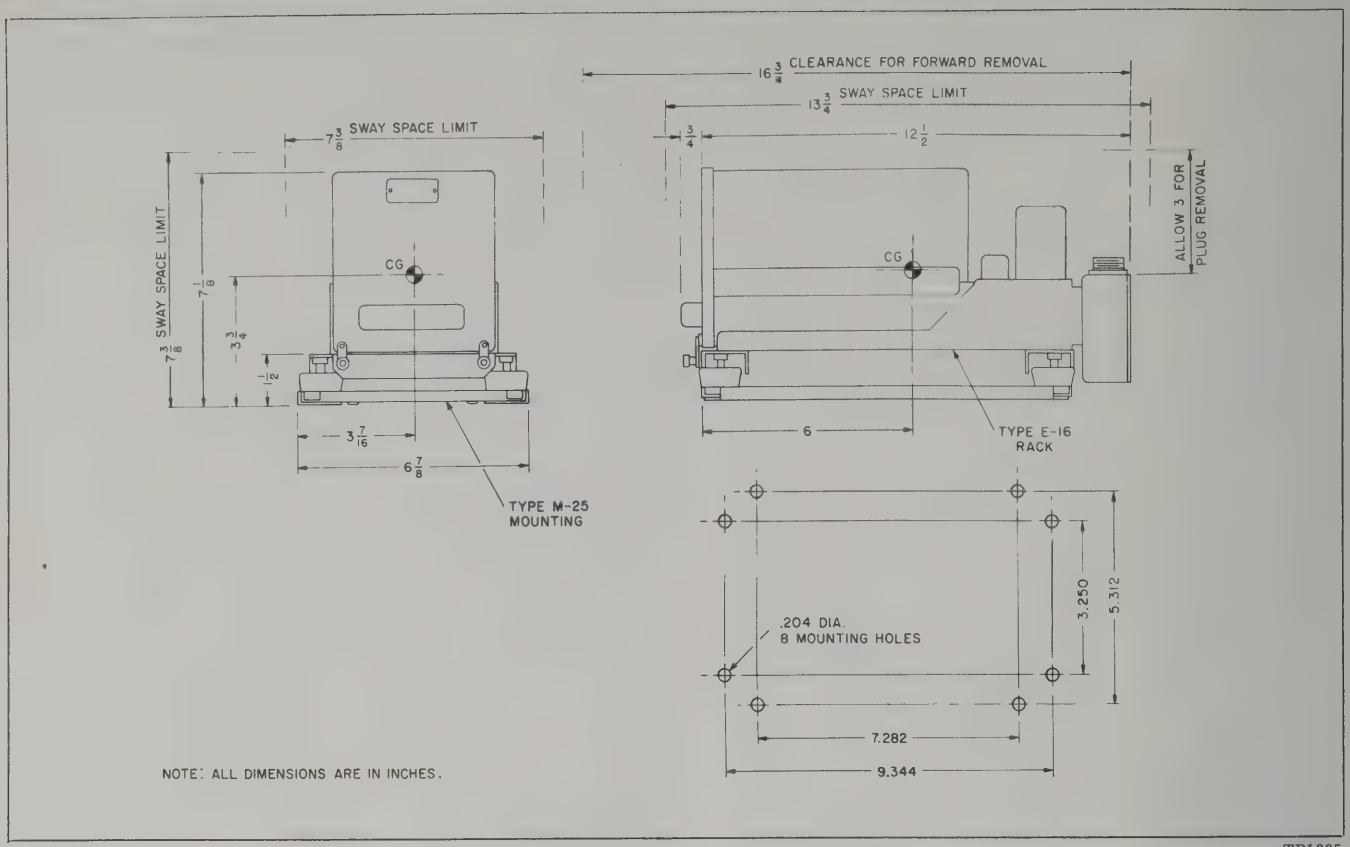
4. Mount the antenna as far as possible from other antennas on the aircraft. Avoid running lead-in wires, or guy wires near the A-13B. Installations where symmetry is maintained with respect to both sides of the antenna will cause the least amount of interaction.

2–4. INSTALLATION OF ANTENNA COUPLER.

The general recommendations made with regard to the installation of the A-13B Antenna in paragraph 2–3 apply also to the installation of the ARC Type A-17 Antenna Coupler. The antenna required for use with the A-17 is to be furnished by the installing agency. The antenna may be formed of two 26-inch long, 1/16-inch diameter brass rods, fastened on the inside of the canopy in a V-shape, and located symmetrically with respect to metallic structures when the canopy is closed. The A-17 is installed at the apex of the V to permit close connection of the antenna to the A-17 terminals. In piston-type aircraft, the A-17 may be mounted inside near the top of the vertical fin, with beryllium copper rods extending out through insulating grommets to form a 60° V. The rods must be placed symmetrically with respect to the vertical fin.

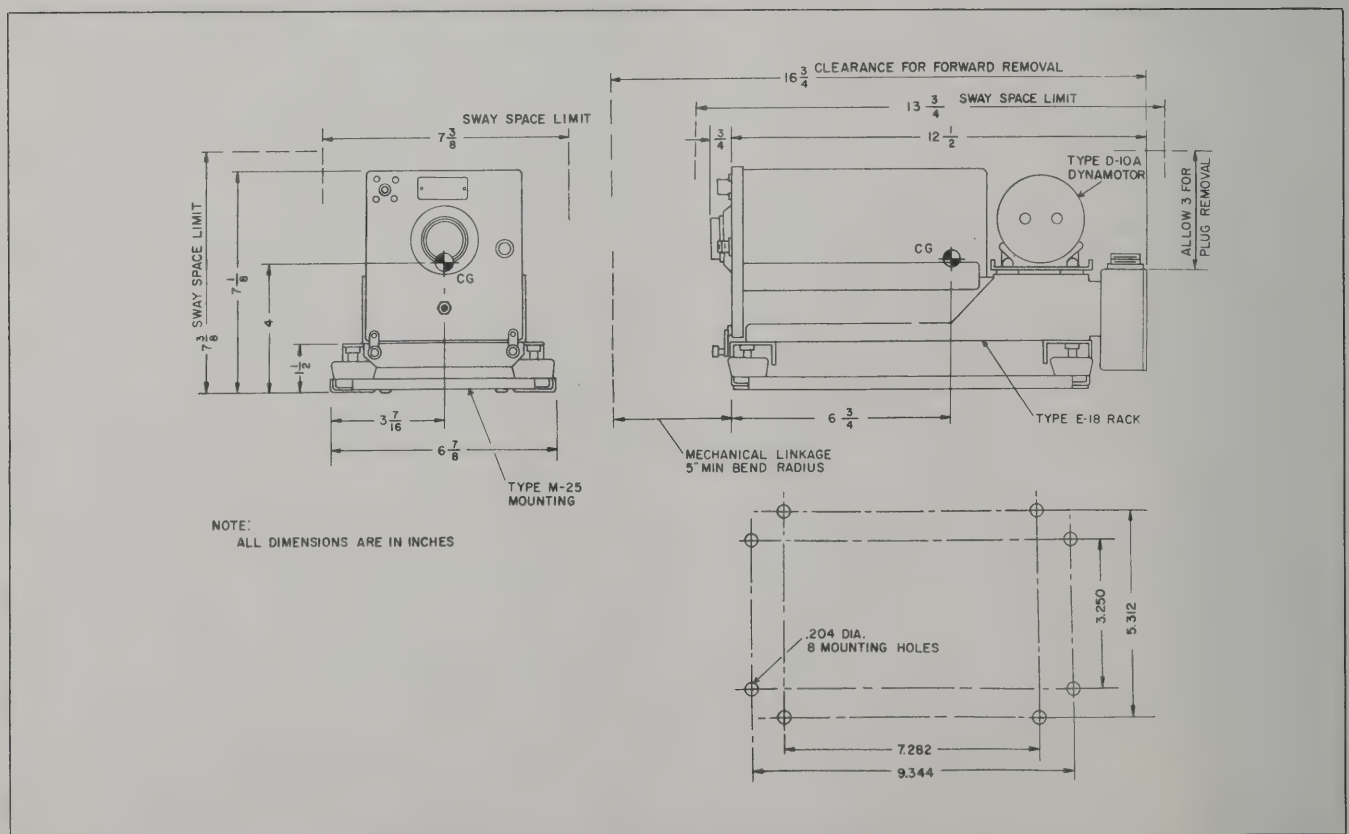
2–5. CABLE ASSEMBLY FABRICATION.

The connectors required for fabricating the interconnecting cables for the 15E are supplied, but the individual wires are not. Open-wire cables are recommended for flexibility, ease of construction, and facility of repair. The required cabling between units is shown in Figures 2–11 and 2–12. The size and number of conductors, and their terminations are shown in Figures 2–13 and 2–14. The final length of the cable assemblies will depend on the location of the equipment in the aircraft.



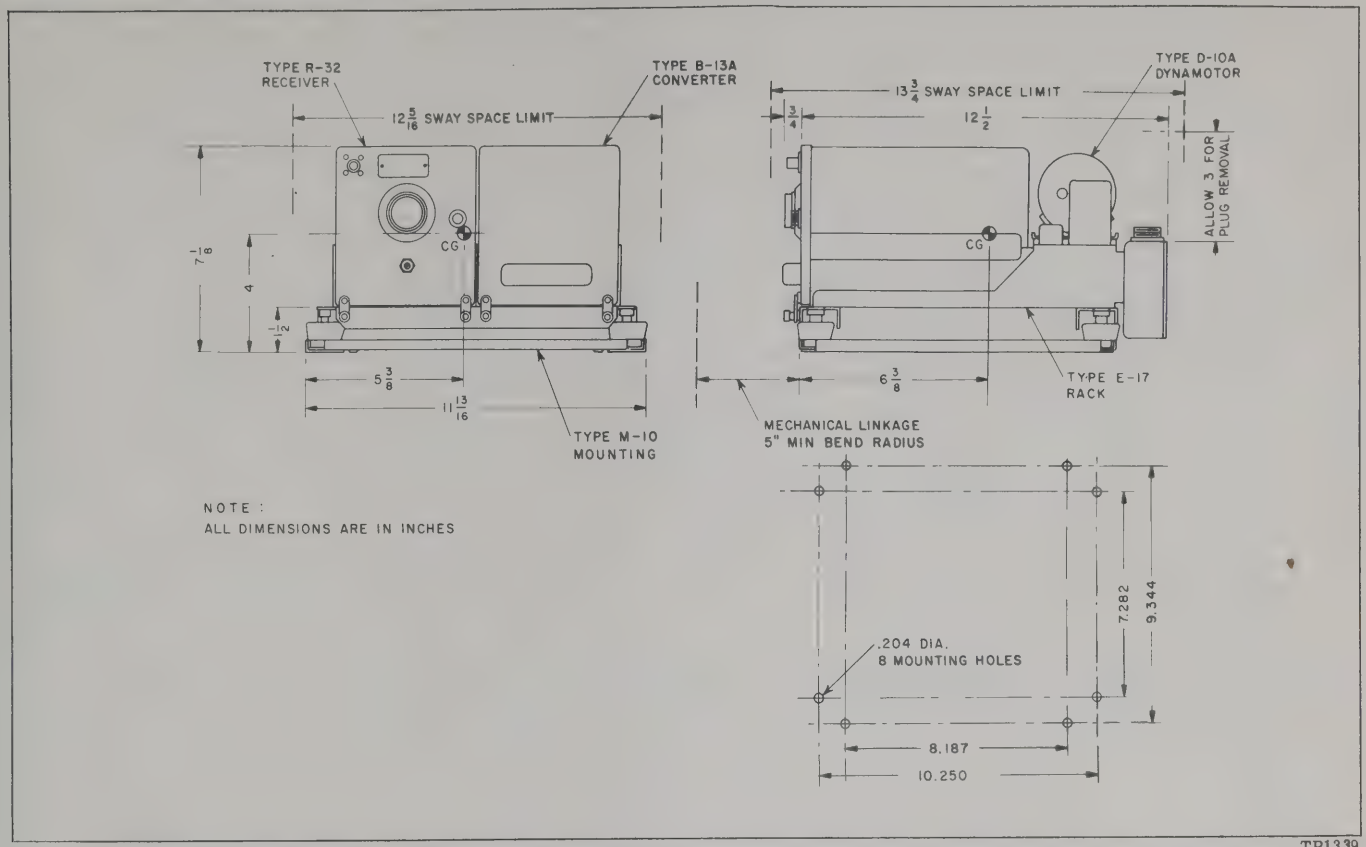
TP1335

Figure 2–1. ARC Type B-13A Converter, Outline Dimensions



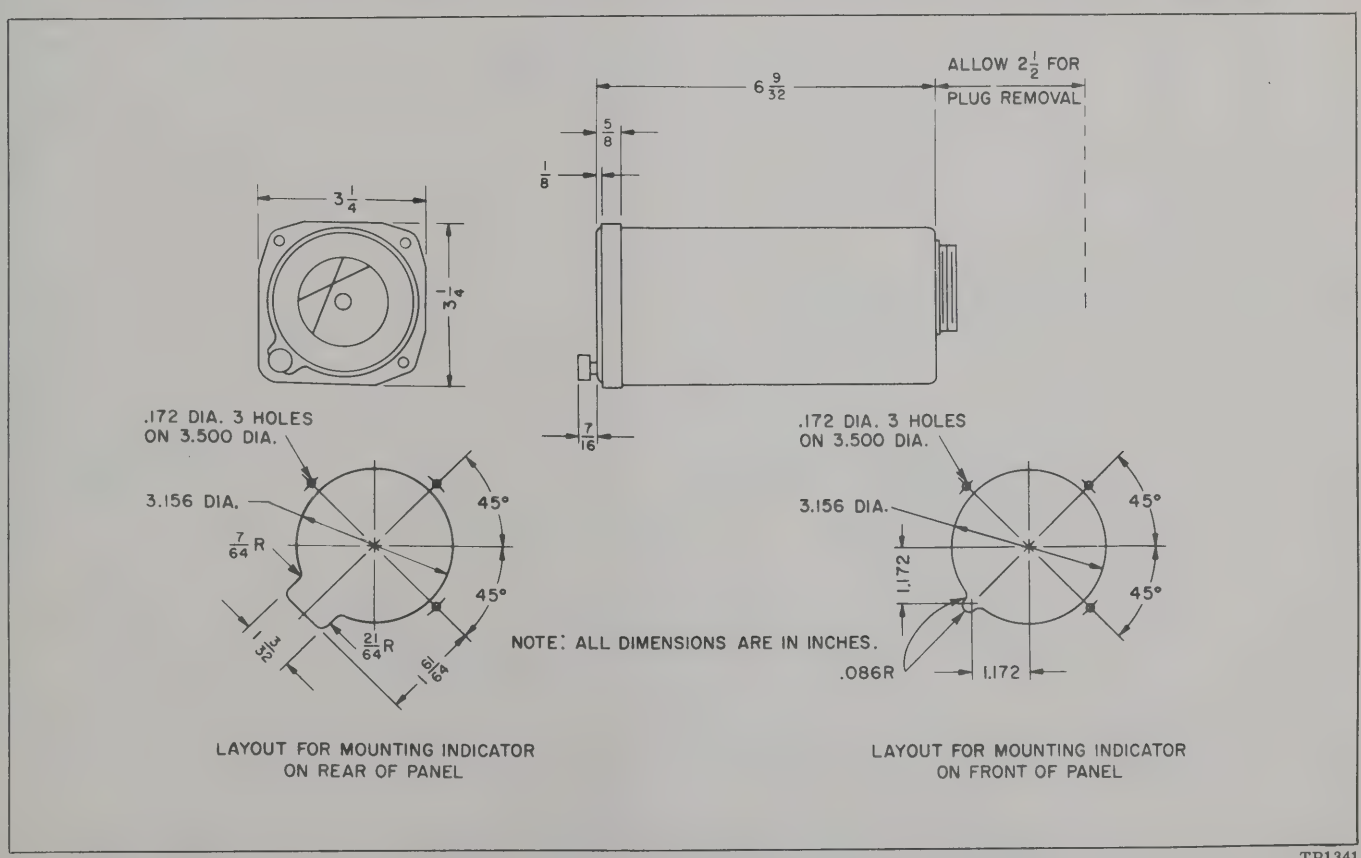
TP1337

Figure 2–2. ARC Type R-32 Receiver, Outline Dimensions



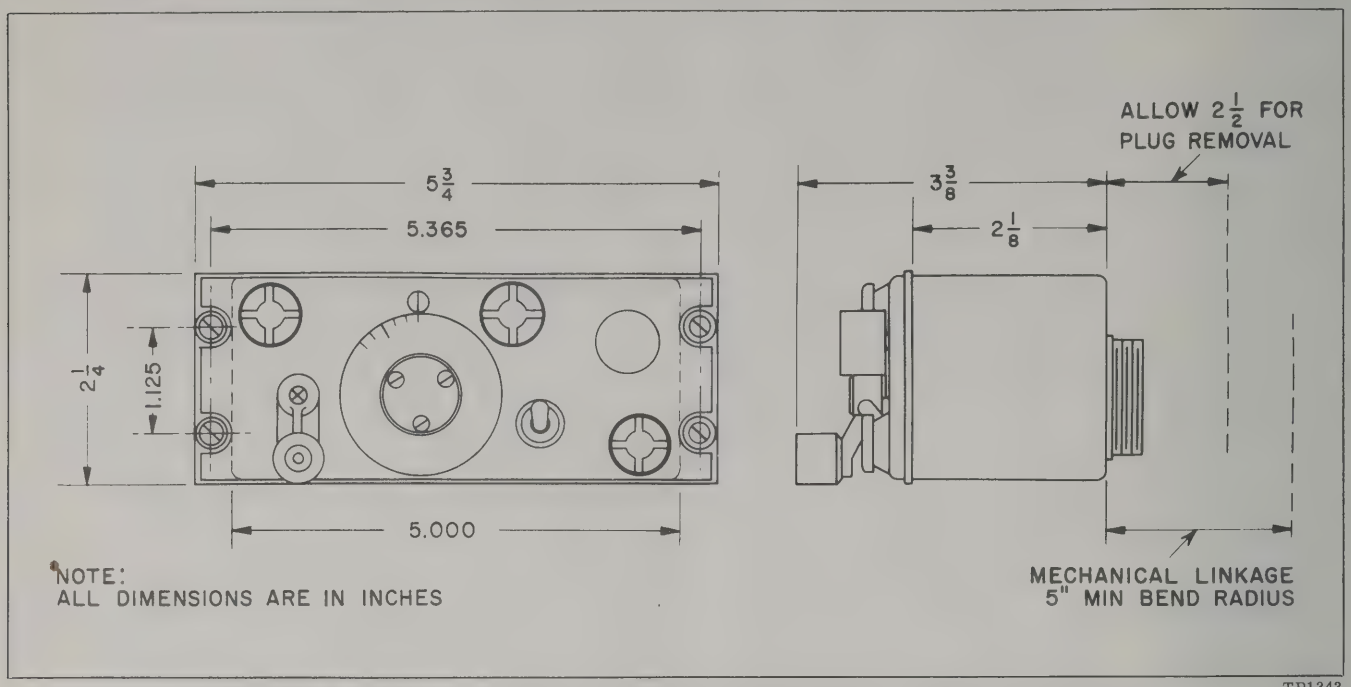
TP1339

Figure 2–3. ARC Type R-32 Receiver and B-13A Converter, One-Rack Mounting, Outline Dimensions



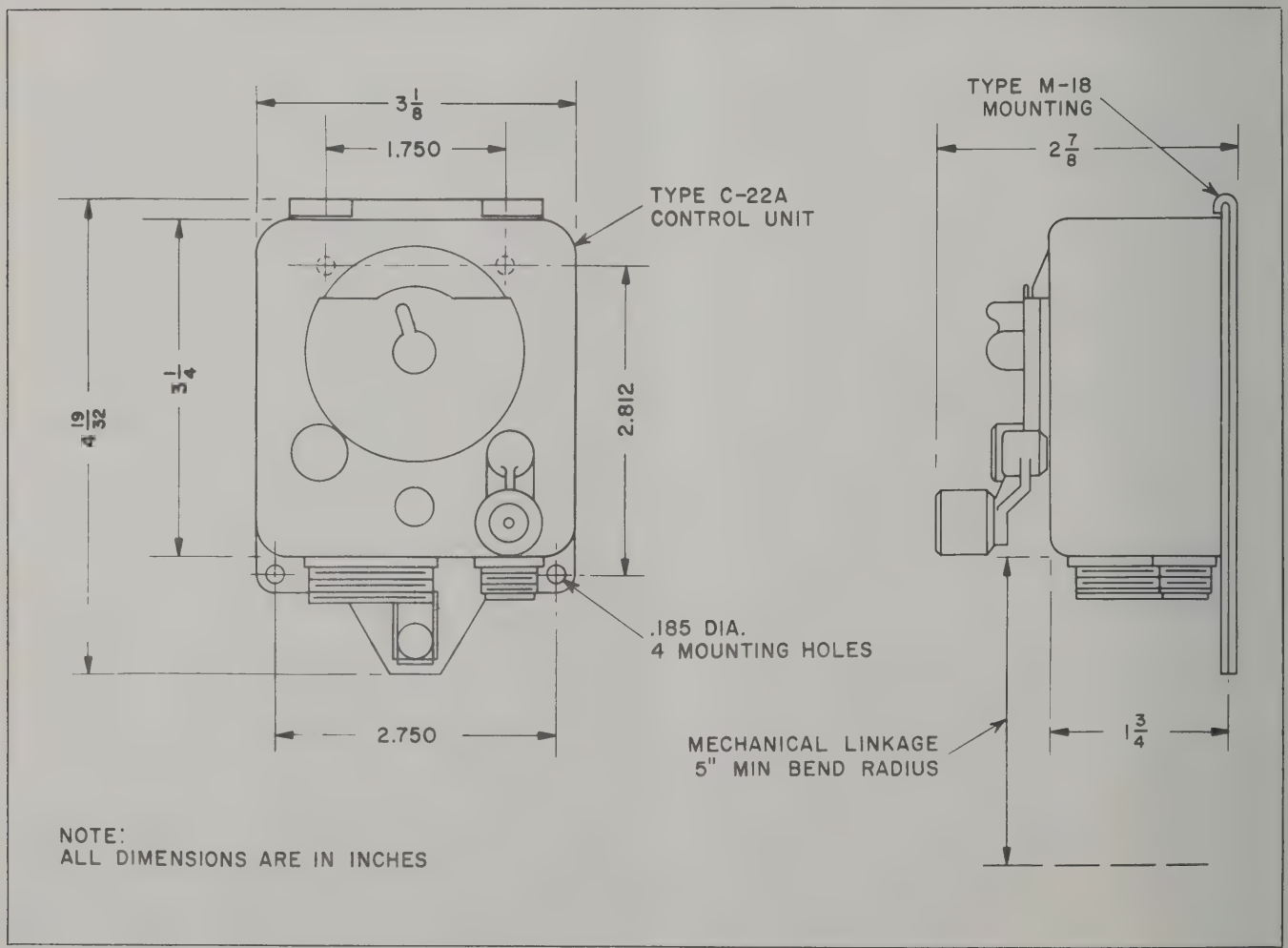
TP1341

Figure 2–4. ARC Type IN-10 Course Indicator, Outline Dimensions



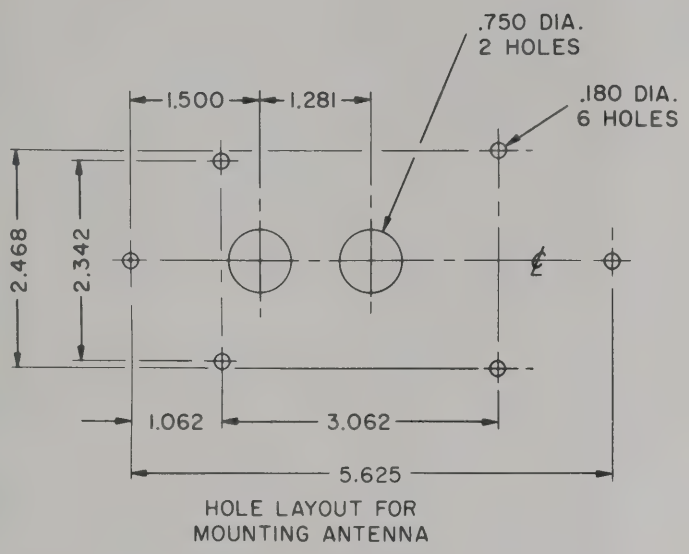
TP1343

Figure 2–5. ARC Type C-1254 and C-1254A Control Units, Outline Dimensions

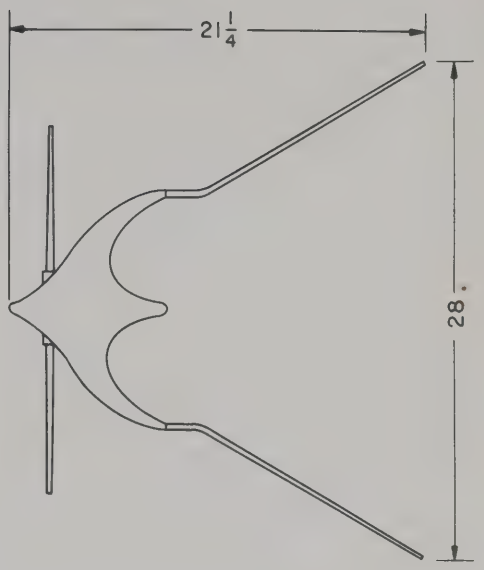


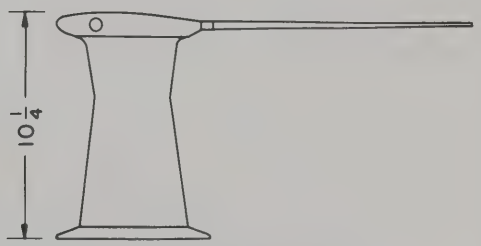
TP1345

Figure 2–6. ARC Type C-22A Control Unit, Outline Dimensions



HOLE LAYOUT FOR
MOUNTING ANTENNA

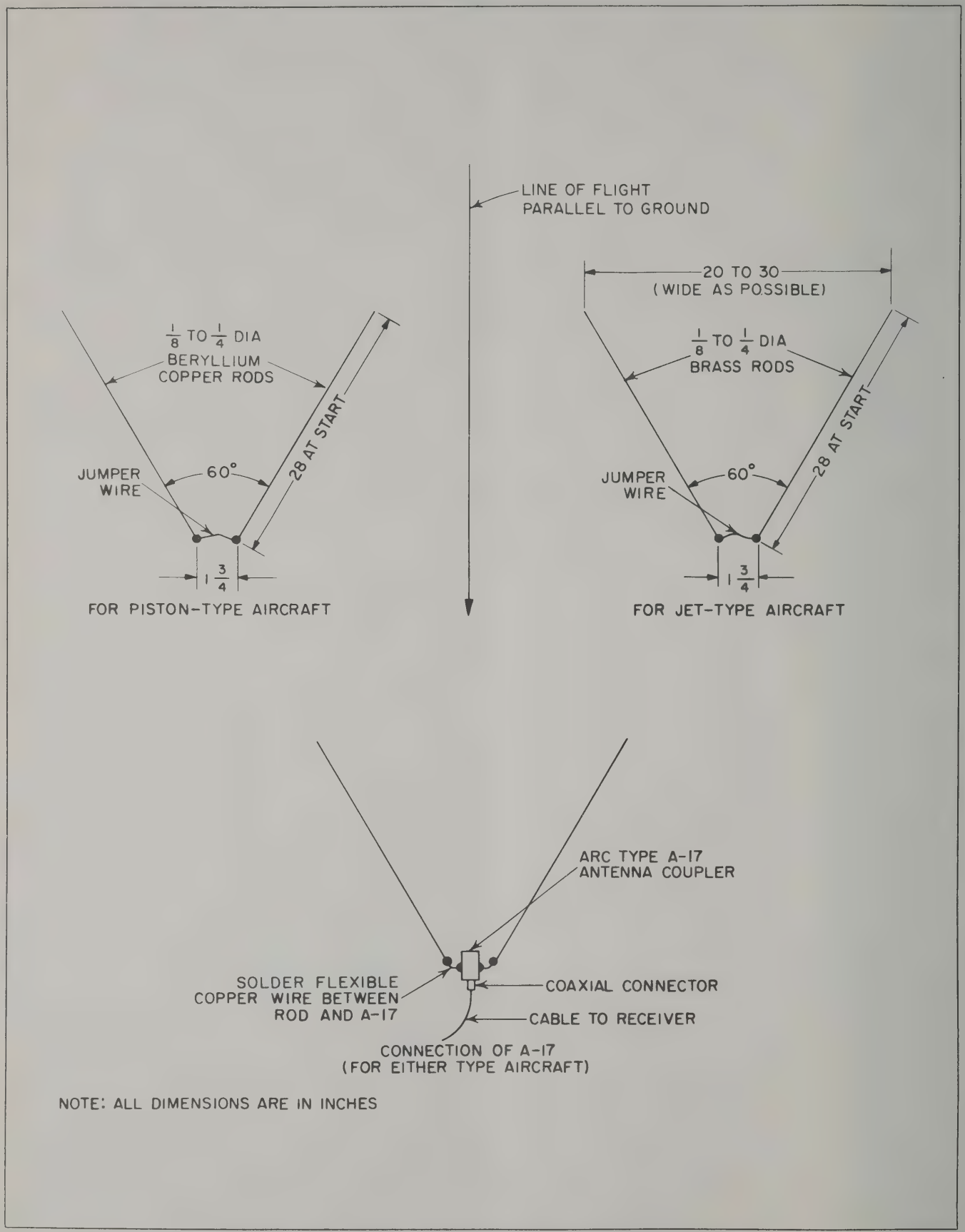




NOTE: ALL DIMENSIONS ARE IN INCHES.

TP1347

Figure 2–7. ARC Type A-13B Antenna, Outline Dimensions



TP1349

Figure 2–8. ARC Type A-17 Antenna Coupler, Installation Diagram

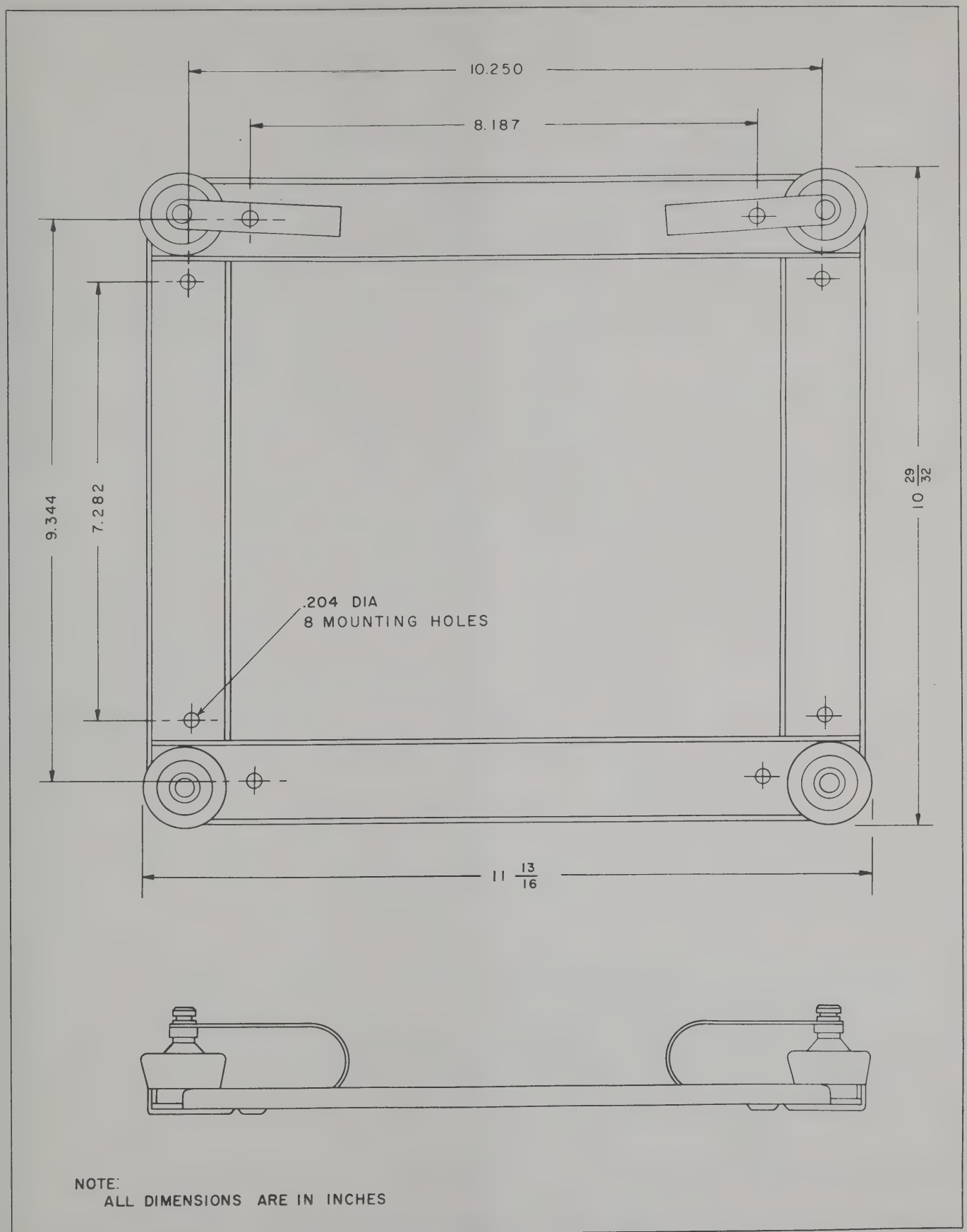
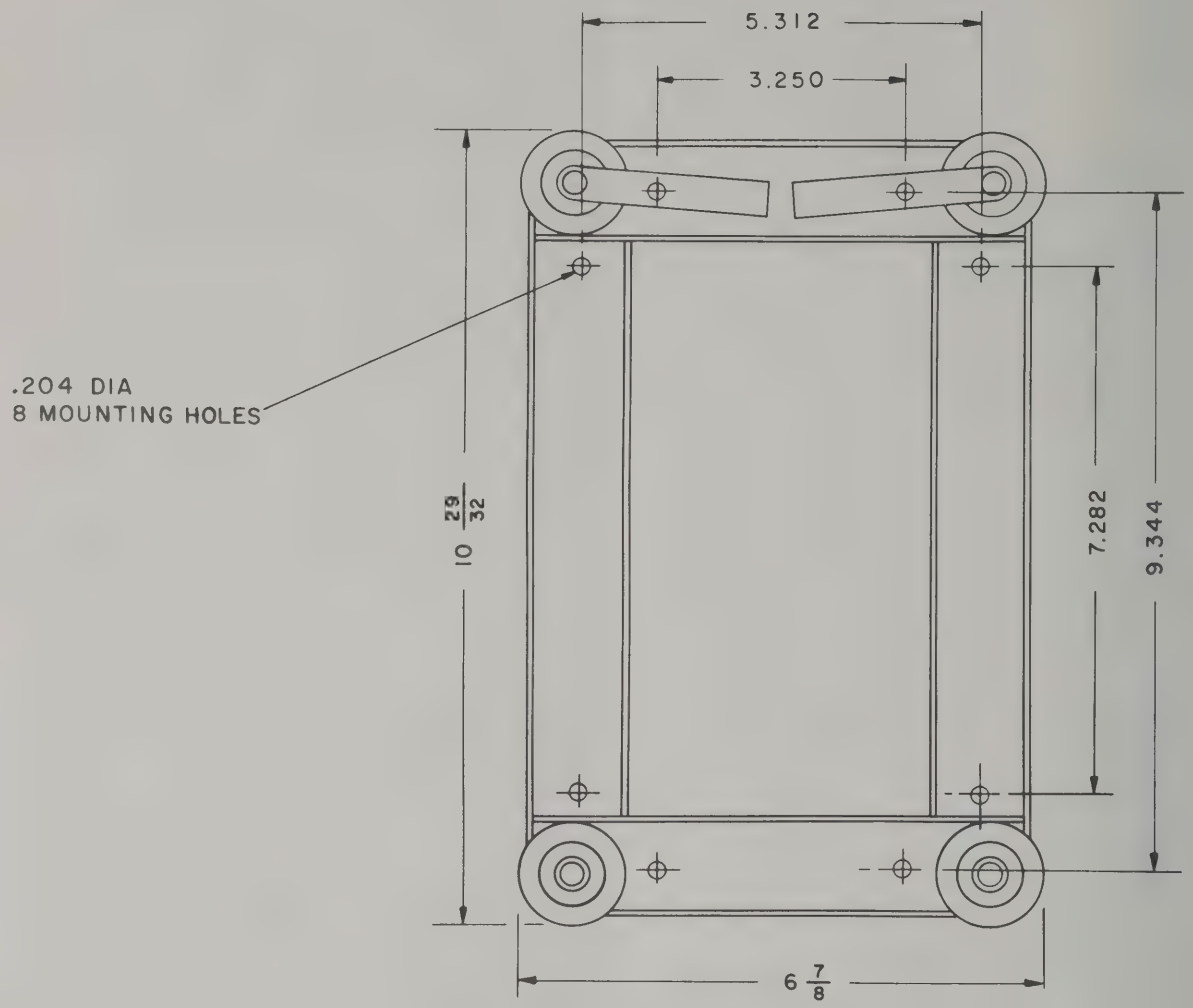
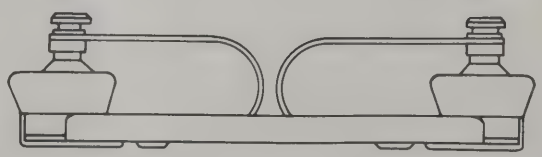


Figure 2–9. ARC Type M-10 Mounting, Outline Dimensions

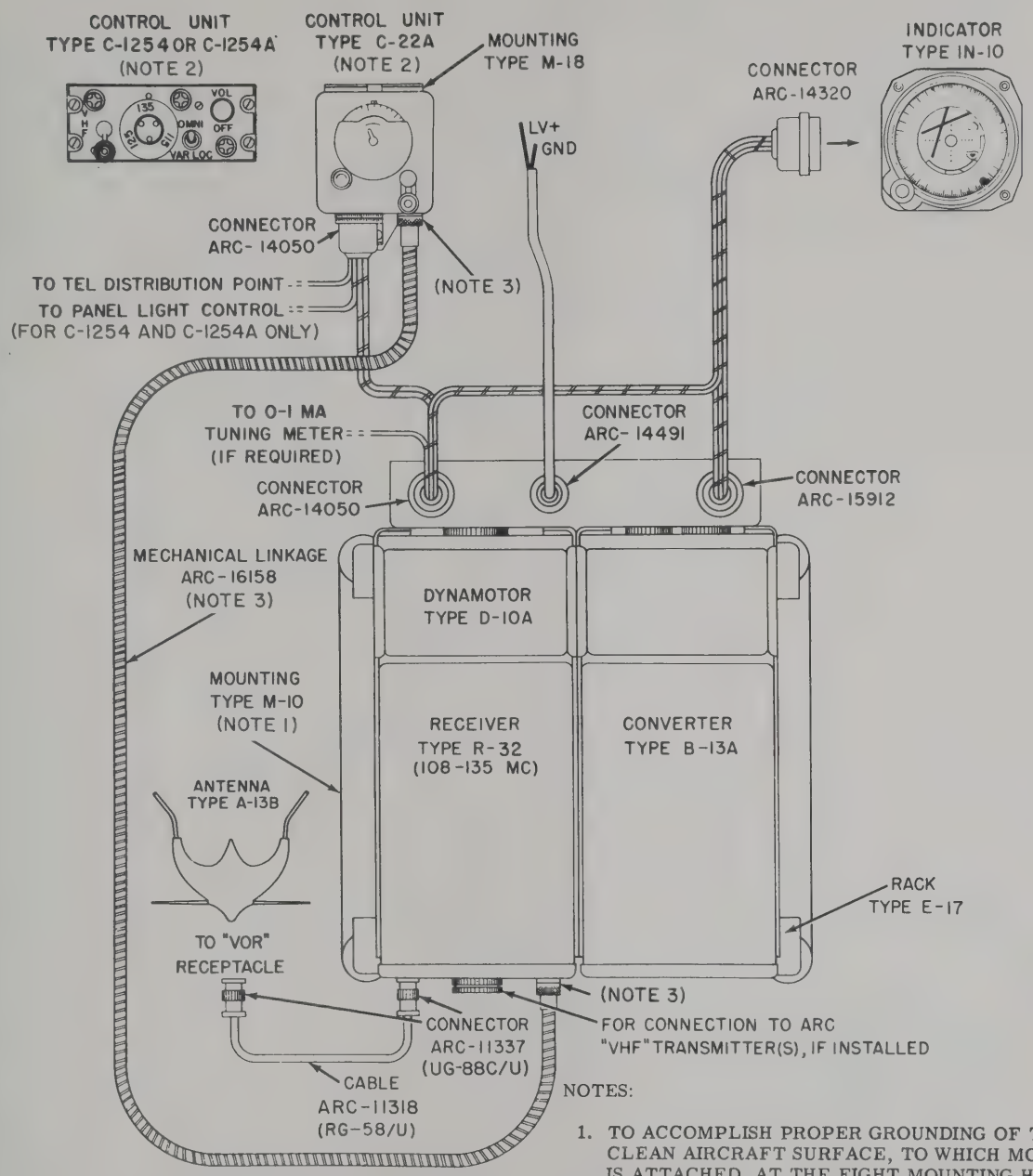


NOTE:
ALL DIMENSIONS ARE IN INCHES



TP1353

Figure 2–10. ARC Type M-25 Mounting, Outline Dimensions

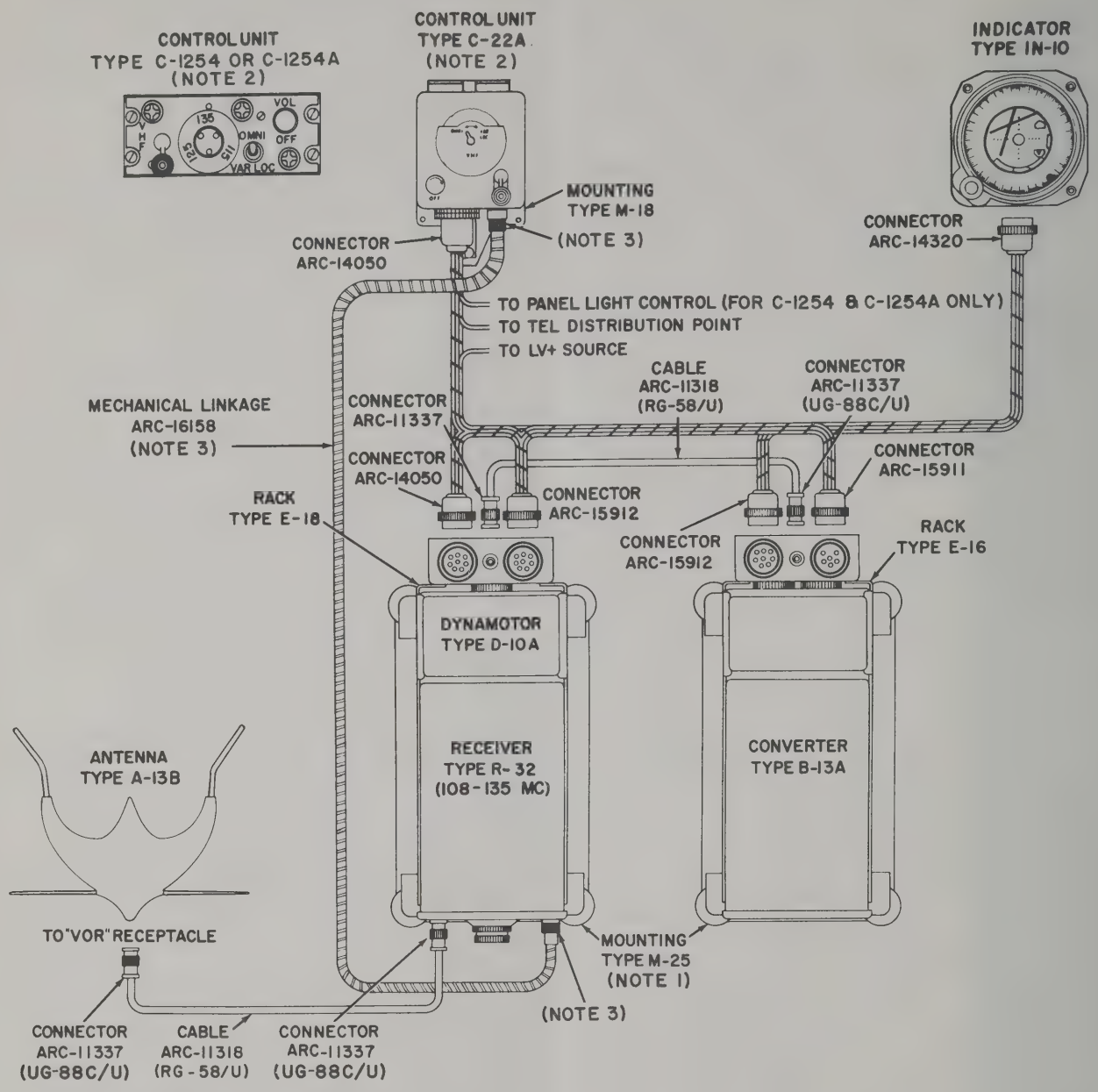


NOTES:

1. TO ACCOMPLISH PROPER GROUNDING OF THIS SYSTEM, CLEAN AIRCRAFT SURFACE, TO WHICH MOUNTING M-10 IS ATTACHED, AT THE EIGHT MOUNTING HOLE POINTS.
2. CONTROL UNIT C-22A WITH MOUNTING M-18, AND CONTROL UNIT C-1254 OR C-1254A ARE ALTERNATIVE UNITS.
3. IF CLEARANCE FOR MINIMUM BEND-RADIUS OF 5 INCHES FOR MECHANICAL LINKAGE IS NOT AVAILABLE, RIGHT-ANGLE COUPLING ARC-6357 SHOULD BE USED AT EITHER OR BOTH ENDS OF MECHANICAL LINKAGE ARC-16158.
4. FOR EXTERNAL WIRING DIAGRAM, SEE FIGURE 2-13.

TP1145A

Figure 2–11. ARC Type 15E Equipment, One-Rack Installation, Intercabling Diagram



NOTES:

1. TO ACCOMPLISH PROPER GROUNDING OF THIS SYSTEM, CLEAN AIRCRAFT SURFACE, TO WHICH MOUNTINGS M-25 ARE ATTACHED, AT THE MOUNTING HOLES.
2. CONTROL UNIT C-22A WITH MOUNTING M-18, AND CONTROL UNIT C-1254 OR C-1254A ARE ALTERNATIVE UNITS.
3. IF CLEARANCE FOR MINIMUM BEND-RADIUS OF 5 INCHES FOR MECHANICAL LINKAGE IS NOT AVAILABLE, RIGHT-ANGLE COUPLING ARC-6357 SHOULD BE USED AT EITHER OR BOTH ENDS OF MECHANICAL LINKAGE ARC-16158.
4. FOR EXTERNAL WIRING DIAGRAM, SEE FIGURE 2-14.

TP1149A

Figure 2–12. ARC Type 15E Equipment, Two-Rack Installation, Intercabling Diagram

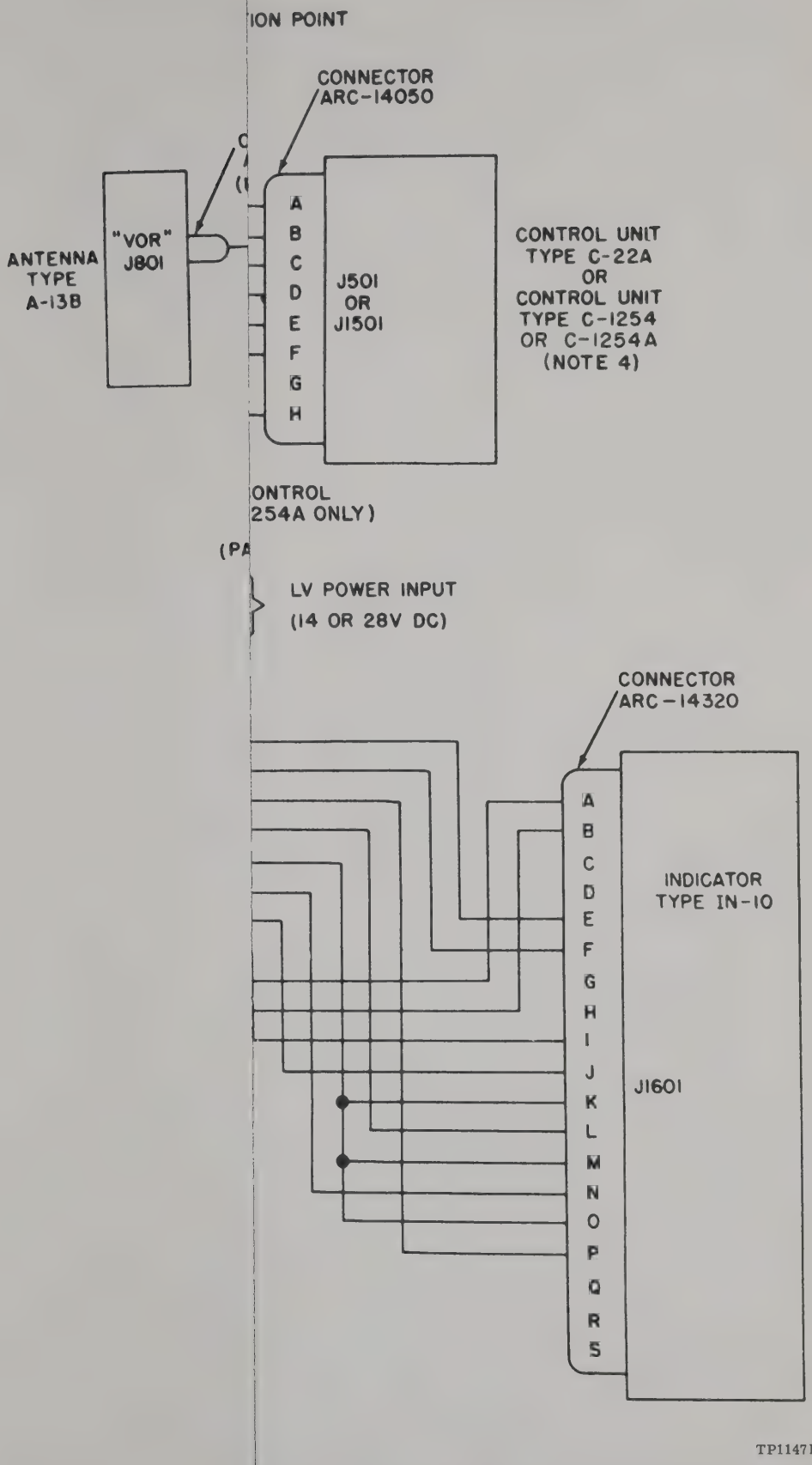
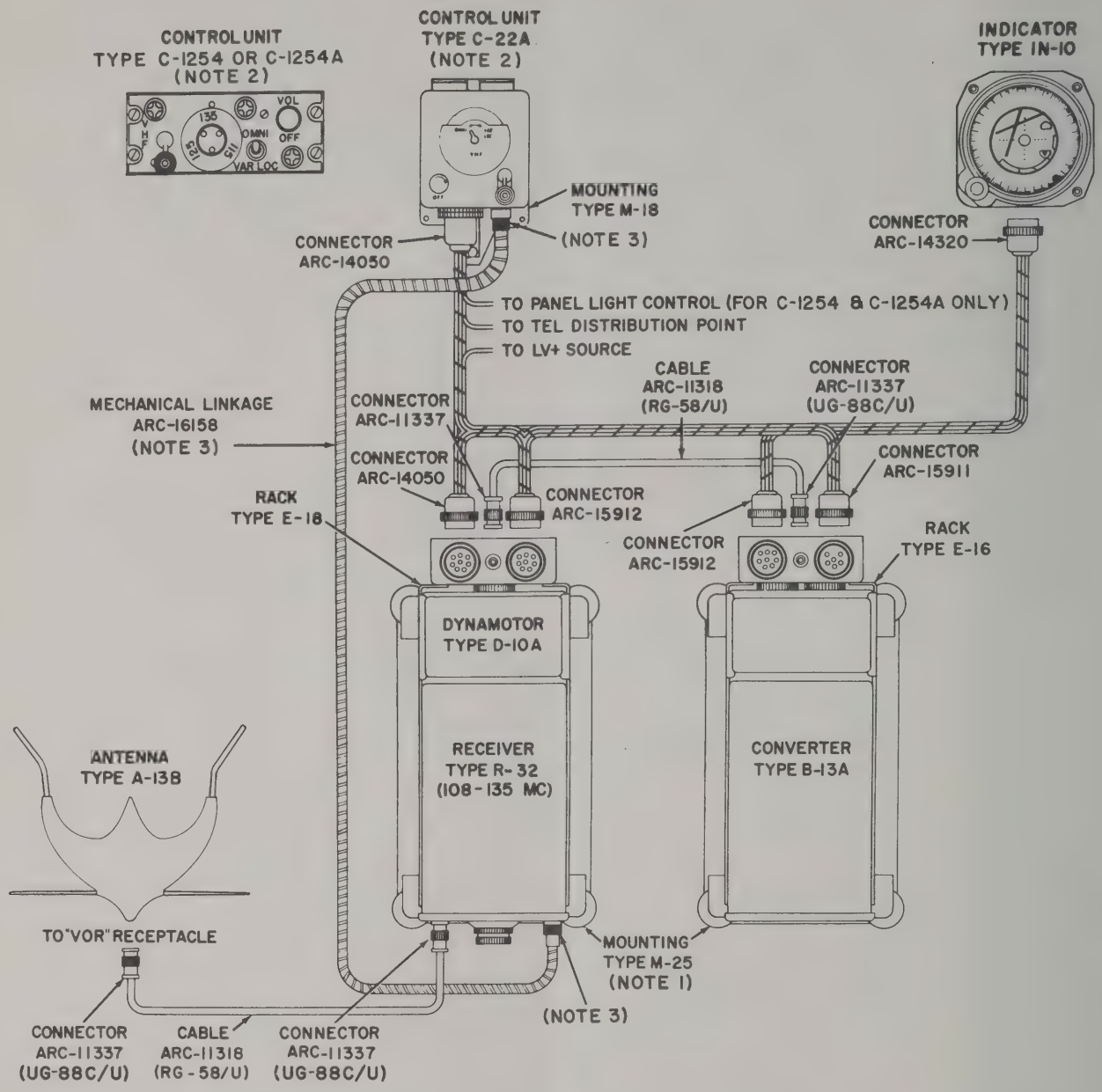


Figure 2–13. ARC Type 15E Equipment, One-Rack Installation, External Wiring Diagram

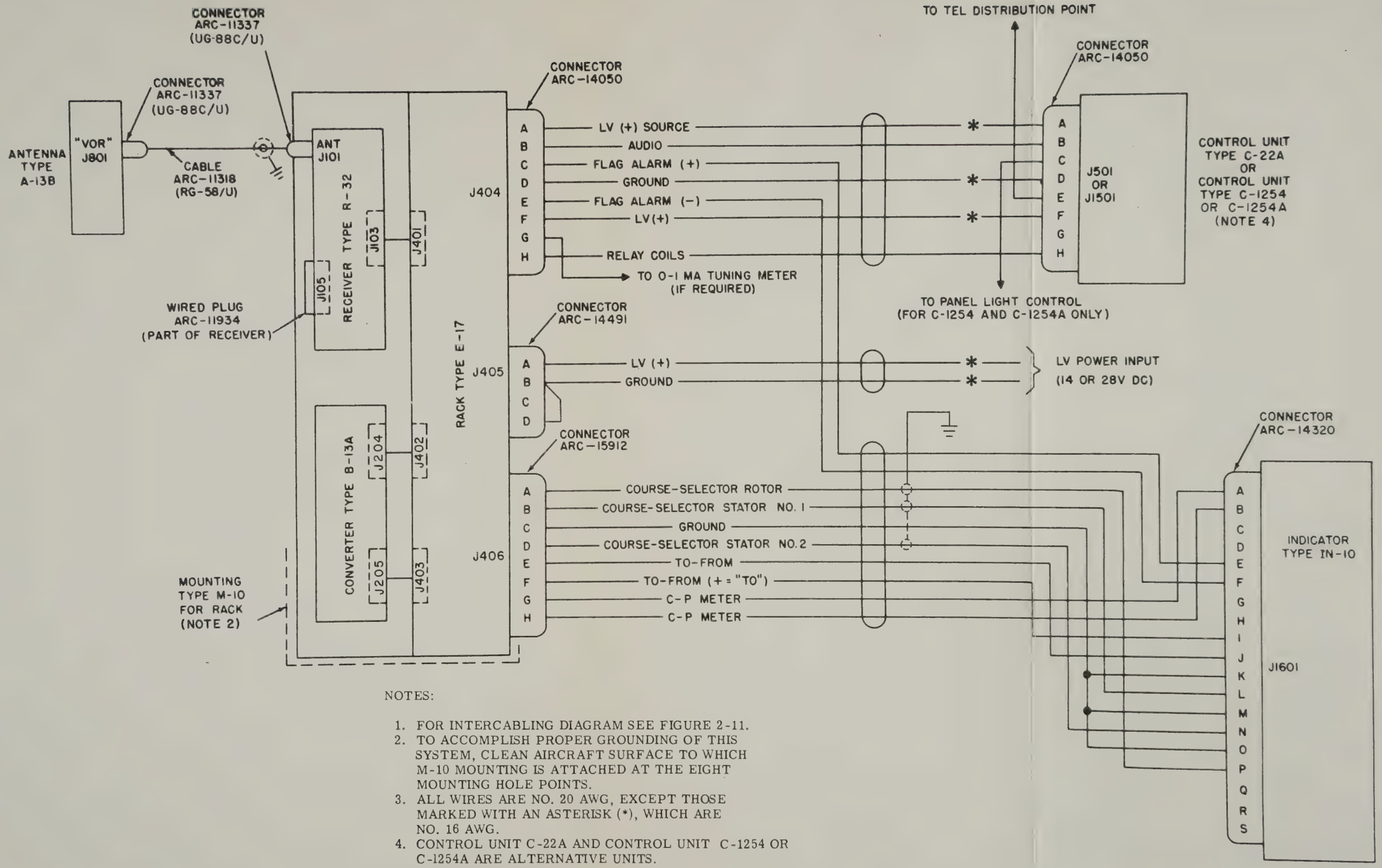


NOTES:

1. TO ACCOMPLISH PROPER GROUNDING OF THIS SYSTEM, CLEAN AIRCRAFT SURFACE, TO WHICH MOUNTINGS M-25 ARE ATTACHED, AT THE MOUNTING HOLES.
2. CONTROL UNIT C-22A WITH MOUNTING M-18, AND CONTROL UNIT C-1254 OR C-1254A ARE ALTERNATIVE UNITS.
3. IF CLEARANCE FOR MINIMUM BEND-RADIUS OF 5 INCHES FOR MECHANICAL LINKAGE IS NOT AVAILABLE, RIGHT-ANGLE COUPLING ARC-6357 SHOULD BE USED AT EITHER OR BOTH ENDS OF MECHANICAL LINKAGE ARC-16158.
4. FOR EXTERNAL WIRING DIAGRAM, SEE FIGURE 2-14.

TP1149A

Figure 2–12. ARC Type 15E Equipment, Two-Rack Installation, Intercabling Diagram

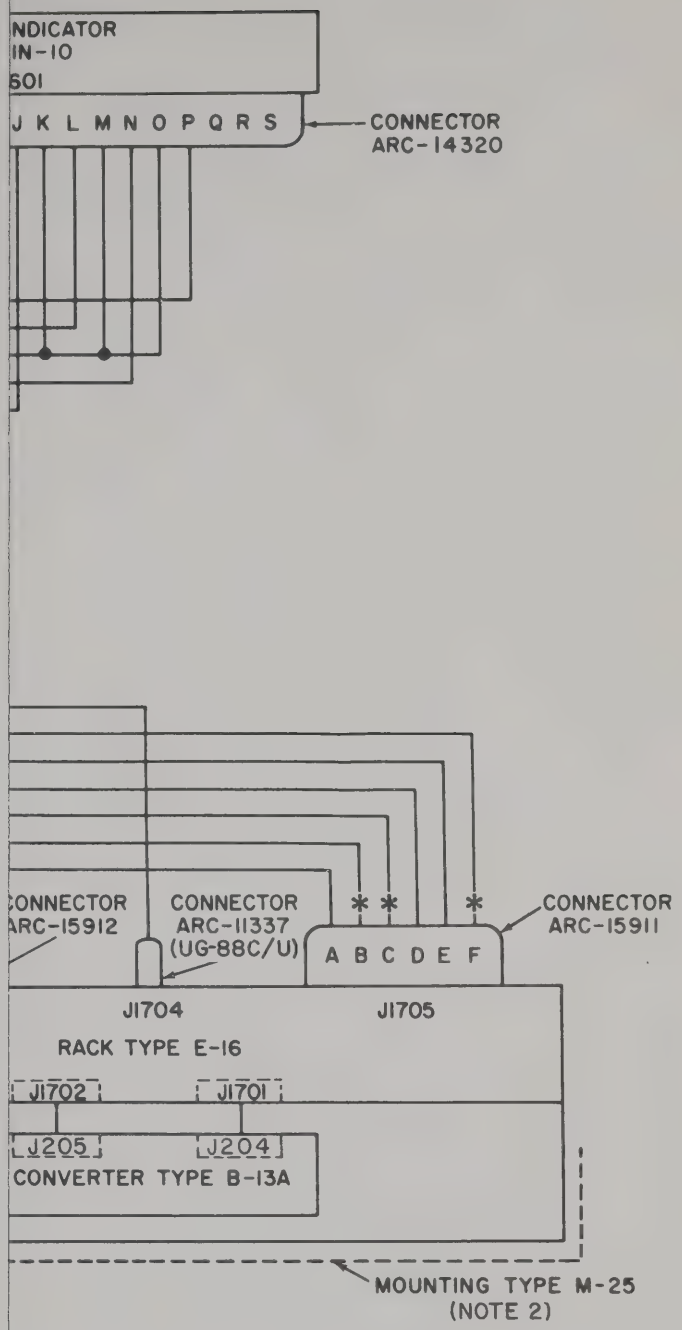


NOTES:

1. FOR INTERCABLING DIAGRAM SEE FIGURE 2-11.
2. TO ACCOMPLISH PROPER GROUNDING OF THIS SYSTEM, CLEAN AIRCRAFT SURFACE TO WHICH M-10 MOUNTING IS ATTACHED AT THE EIGHT MOUNTING HOLE POINTS.
3. ALL WIRES ARE NO. 20 AWG, EXCEPT THOSE MARKED WITH AN ASTERISK (*), WHICH ARE NO. 16 AWG.
4. CONTROL UNIT C-22A AND CONTROL UNIT C-1254 OR C-1254A ARE ALTERNATIVE UNITS.

TP1147B

Figure 2–13. ARC Type 15E Equipment, One-Rack Installation, External Wiring Diagram

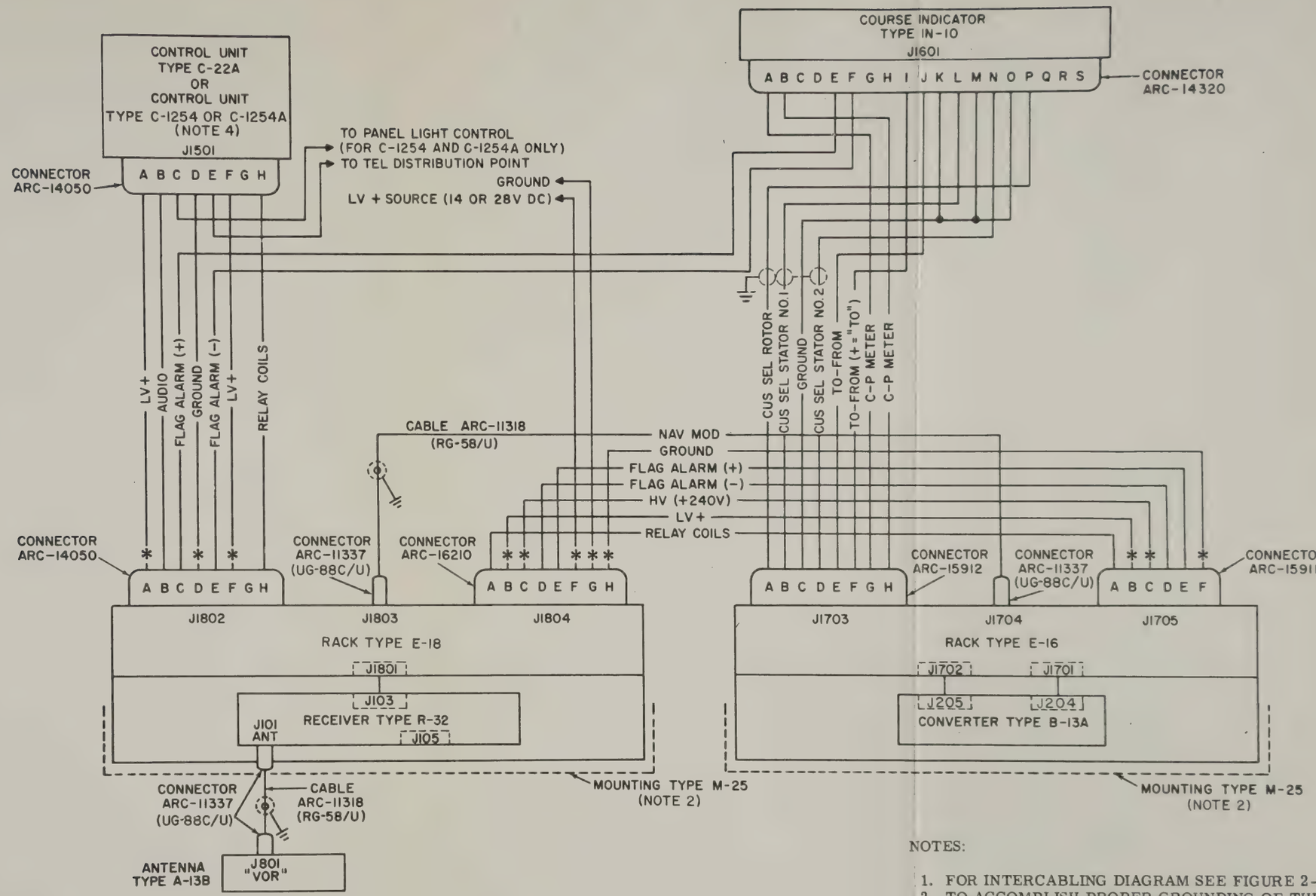


NOTES:

1. FOR INTERCABLING DIAGRAM SEE FIGURE 2-12.
2. TO ACCOMPLISH PROPER GROUNDING OF THIS SYSTEM, CLEAN AIRCRAFT SURFACE TO WHICH M-25 MOUNTING IS ATTACHED AT THE EIGHT MOUNTING HOLE POINTS.
3. ALL WIRES ARE NO. 20 AWG, EXCEPT THOSE MARKED WITH AN ASTERISK (*), WHICH ARE NO. 16 AWG.
4. CONTROL UNITS C-22A, C-1254, AND C-1254A ARE ALTERNATIVE UNITS.

TP1151B

Figure 2–14. ARC Type 15E Equipment, Two-Rack Installation, External Wiring Diagram



NOTES:

1. FOR INTERCABLING DIAGRAM SEE FIGURE 2-12.
2. TO ACCOMPLISH PROPER GROUNDING OF THIS SYSTEM, CLEAN AIRCRAFT SURFACE TO WHICH M-25 MOUNTING IS ATTACHED AT THE EIGHT MOUNTING HOLE POINTS.
3. ALL WIRES ARE NO. 20 AWG, EXCEPT THOSE MARKED WITH AN ASTERISK (*), WHICH ARE NO. 16 AWG.
4. CONTROL UNITS C-22A, C-1254, AND C-1254A ARE ALTERNATIVE UNITS.

TP1151B

Figure 2–14. ARC Type 15E Equipment, Two-Rack Installation, External Wiring Diagram

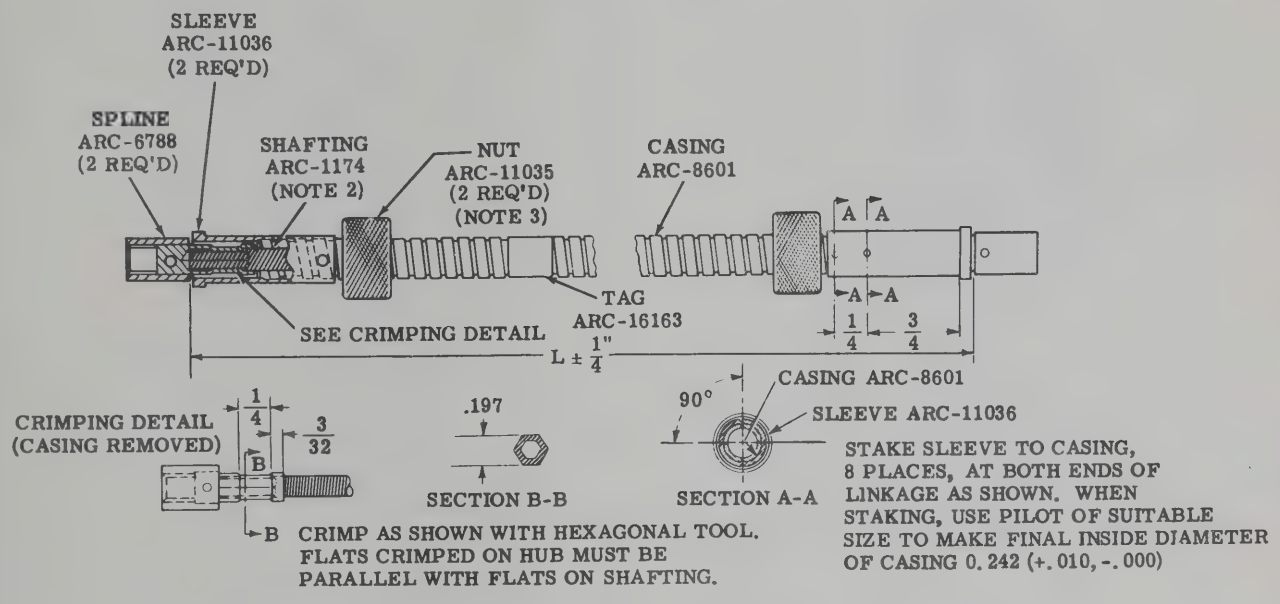
2–6. MECHANICAL LINKAGE.

Mechanical Linkage Parts. The parts required to fabricate the ARC-16158 Mechanical Linkage are as follows:

Name	Part Number
Shafting	ARC-1174
Casing	ARC-8601
Spline	ARC-6788
Sleeve	ARC-11036
Nut	ARC-11035
Tag	ARC-16163

Assembly of Mechanical Linkage. The procedure for assembling the ARC-16158 Mechanical Linkage using Mechanical Linkage Tool ARC Type W-10 is outlined in this paragraph. In addition to the W-10, a 1½- to 2-pound hammer, a hacksaw, side cutters, and a file are required. For reference, an assembly drawing is shown in Figure 2–15. To assemble the Mechanical Linkage, proceed as follows:

Step 1. Determine the length of ARC-1174 Shafting required.


SLEEVE ARC-11036 (2 REQ'D)
SPLINE ARC-6788 (2 REQ'D)
SHAFTING ARC-1174 (NOTE 2)
NUT ARC-11035 (2 REQ'D) (NOTE 3)
CASING ARC-8601
TAG ARC-16163
SEE CRIMPING DETAIL
L ± 1/4"
A A
A A
1/4
3/4
CRIMPING DETAIL (CASING REMOVED)
1/4
3/32
B
B
.197
SECTION B-B
90°
CASING ARC-8601
SLEEVE ARC-11036
SECTION A-A
STAKE SLEEVE TO CASING, 8 PLACES, AT BOTH ENDS OF LINKAGE AS SHOWN. WHEN STAKING, USE PILOT OF SUITABLE SIZE TO MAKE FINAL INSIDE DIAMETER OF CASING 0.242 (+.010, -.000)
CRIMP AS SHOWN WITH HEXAGONAL TOOL. FLATS CRIMPED ON HUB MUST BE PARALLEL WITH FLATS ON SHAFTING.

NOTES:

1. ALL DIMENSIONS IN INCHES.
2. BEFORE ASSEMBLY, LUBRICATE SHAFTING WITH A SLIGHT AMOUNT OF ESSO "UNIVIS NO. 40" OIL, OR EQUIVALENT.
3. BEFORE ASSEMBLY, APPLY ANTI-SEIZE LUBRICANT TO THREADS OF NUTS.

ASSEMBLY PROCEDURE:

NOTE
USE ONLY IF ARC TYPE W-10 ASSEMBLY TOOL IS NOT AVAILABLE

STEP 1. CUT SHAFTING TO REQUIRED LENGTH "L."

STEP 2. WITH CASING STRETCHED BY A FORCE OF 15 POUNDS, CUT CASING LONGER THAN SHAFTING BY 1/4 OF AN INCH PER FOOT, LESS 1 INCH. PUSH BACK CASING AS REQUIRED TO ASSEMBLE SPLINES ON SHAFTING.

STEP 3. STAKE CASING TO SLEEVE. REFER TO "SECTION A-A" DETAIL.

STEP 4. CRIMP SPLINE. REFER TO CRIMPING DETAIL.

16158F

Figure 2–15. ARC-16158 Mechanical Linkage, Assembly Diagram

Step 2. Using a 1½- to 2-pound hammer, insert the shafting in the SWAGE SHAFTING position of the assembly tool (Figure 2–16), and with the shafting centered at the proposed cut-off point, swage the shafting for approximately 1½ inches. Use a hammer-blow force only sufficient to drive the two halves of the tool together. If necessary, repeat the hammer blows to swage the shafting properly.

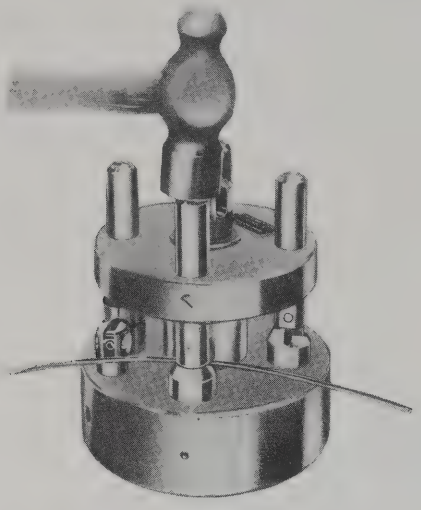


Figure 2–16. Swaging Shafting TP1210

Step 3. Set the swaged portion of the shafting in the CUT SHAFTING position of the tool (Figure 2–17), and using a hammer blow *only heavy enough to effect the cut-off,* cut the shafting at the cut-off point.

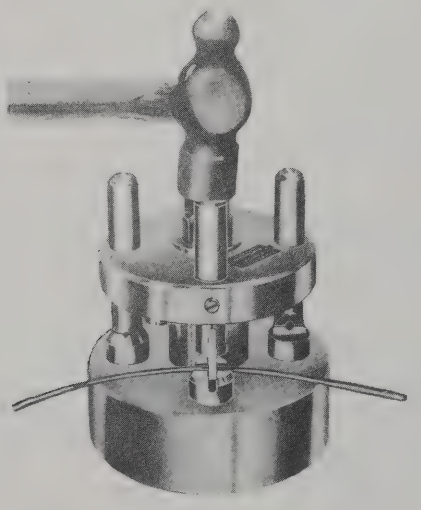


Figure 2–17. Cutting Shafting TP1212

Step 4. Mark off *exactly* 1 foot on the casing. Grasp each end of this marked-off portion and collapse it. Measure the decrease in length between marks. Next, lay out somewhat more casing than will be used and saw the casing (Figure 2–18) longer than the shafting length (Step 3) by one-half the decrease measured in this step (Step 4), for each foot of shaft length. For example: A 10-foot length of shafting is required (Step 1). It is swaged (Step 2) and cut (Step 3). The 1-foot length of casing (Step 4), when collapsed, measures 11½ inches, a decrease of ½ inch. For each foot of shafting ¼ inch is added to the casing, making a total of 10 feet 2½ inches.

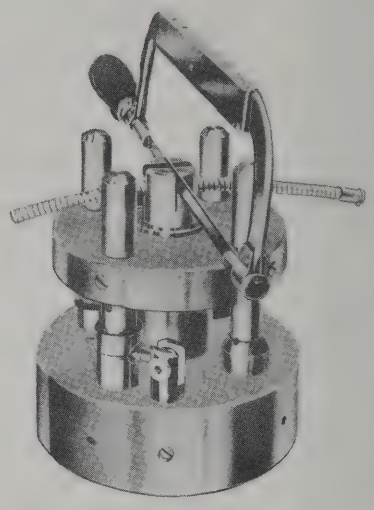


Figure 2–18. Sawing Casing TP1214

Step 5. Using side cutters and a file, trim the burrs from the end of the casing.

Step 6. Place a nut over the casing with the threaded end toward the end of the casing.

Step 7. Place the sleeve over the end of the casing and insert the casing into the sleeve as far as possible. Make sure the casing butts against the inner end of the sleeve. Push the sleeve and casing onto the guide pin of the tool until the end of the sleeve is against the tool post. Swing the sleeve and pin into the STAKE CASING position (Figure 2–19) and strike a hammer blow only

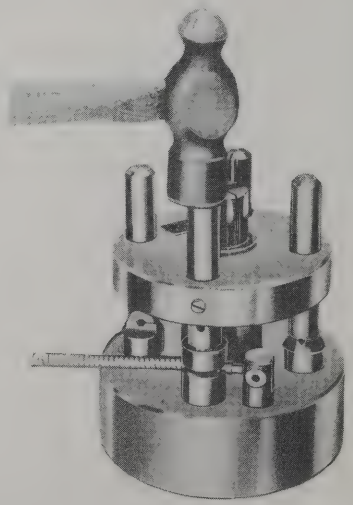


Figure 2–19. Staking Casing TP1216

hard enough to drive the two halves of the tool together. Rotate the casing 90° and stake the sleeve to the casing again. Stake the remaining 90° positions.

Step 8. Repeat Step 7 at the other end of the casing.

Step 9. Push the spline over the swaged end of the shafting as far as it will go. Center the hub of the spline, with the shafting inserted, in the CRIMP SPLINE position on the tool (Figure 2–20); crimp the spline to the shafting using a fairly sharp hammer blow. Strike the tool only hard enough to drive the two halves of the tool together. If necessary, repeat the hammer blow for proper crimping. Make certain that flats crimped on shafting are parallel to flats on the tool.

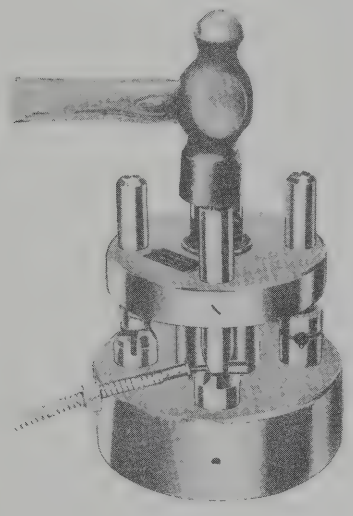


Figure 2–20. Crimping Spline TP1218

Step 10. Lubricate the shafting lightly with clock and watch oil. Insert the shafting into the casing. Push back the casing as required to expose the swaged end of the shafting. Use a thin wrapping of tape to prevent the shafting from sliding back into the casing. Repeat Step 9 to complete the mechanical linkage.

Step 11. Lubricate the threads of the nuts with an anti-seize compound.

Installation of Mechanical Linkage. A properly assembled mechanical linkage, up to 25 feet long, will work smoothly, provided it is installed properly. The following installation recommendations will help to obtain proper operation of the mechanical linkage:

1. Plan the route of the linkage for a minimum number of bends.

2. In some installations, to reduce the number of bends, consider the use of right-angle couplings, ARC-6357, instead of the usual straight connection. When these couplings are used, they should be connected preferably at the control unit end of the linkage.

3. Keep all bends to as large a radius as possible, without excessive length. Do not use a radius of less than 10 inches if length exceeds 7 feet. A minimum radius of 5 inches may be used on shorter lengths, but not more than one such bend should be used.

4. Do not lace the mechanical linkage together with cables; instead, secure it separately to the airframe in as few places as possible, and just tight enough to hold it in place. Do not attempt to absorb excess length by "snaking" the linkage.

Storage of Mechanical Linkage Parts. Improperly stored mechanical linkage parts used for assembly may make the assembling process difficult and lead to improperly operating linkages. Store bulk lengths of casing and shafting on a 15- to 24-inch diameter reel. Never hang the loops of casing or shafting on a hook, or place them on an open shelf. Such storage may cause kinking, twisting, or other types of distortion. Do not allow dust or grit to accumulate on the threads of the spline or nut; keep them in covered containers. If lengths of assembled mechanical linkage are stored, cover the ends with a plastic cap similar to ARC-16917.

2–7. ADJUSTMENTS AFTER INSTALLATION.

Tuning Dial. After installing the Type 15E, the control unit frequency dial and the receiver tuning capacitor must be aligned. To do this, proceed as follows:

Step 1. With the mechanical linkage connected between the control unit and the receiver, turn the tuning crank counterclockwise as far as it will go to bring the receiver tuning capacitor to its minimum capacitance setting. Do not force beyond this point.

Step 2. Disconnect the mechanical linkage at either the receiver or control unit, whichever is more convenient.

Step 3. Turn the tuning crank until the small dot about ⅛ inch beyond the high-frequency end of the dial comes directly under the fiducial mark.

Step 4. Reconnect the mechanical linkage.

Step 5. Accurately tune in a station of known frequency, or use a signal source of known frequency, such as a signal generator.

Step 6. Being careful not to disturb the tuning position of Step 5, again disconnect the mechanical linkage.

Step 7. Set the frequency dial to the *exact* reading of the signal source frequency.

Step 8. Taking care not to disturb the setting of the frequency dial or the position of the mechanical linkage gear, reconnect the mechanical linkage.

Step 9. Test the comparative tuning accuracy of the control unit and receiver by tuning in several stations of known frequency across the band, or by using other

sources of known frequency. If the accuracy of the dial readings, as compared to the signal frequencies, differs by more than the width of one subdivision indice line (approximately 1/32 inch), repeat Steps 1 through 8.

Squelch Control. The squelch control on the R-32 Receiver is set as follows:

Step 1. Loosen the squelch control locknut and turn the squelch control fully clockwise.

Step 2. Tune the receiver to a point where no signal is received.

Step 3. With the aircraft's engines and all electrical equipment operating normally, adjust the squelch control counterclockwise until the receiver noise output is just barely audible.

Step 4. Tighten the squelch control locknut, being careful not to disturb the control setting.

Whistle-through Tuning. If the Type 15E is to be used with an ARC transmitter to form a vhf communication system, the signal level of the whistle-through tuning must be adjusted. Procedures for this adjustment are contained in the appropriate ARC transmitter instruction book.

2–8. OPERATIONAL CHECKS.

General. An operational check of the equipment should be made after installation using an ARC Type H-14A Signal Generator, or equivalent, as a signal source. Either a ramp test or a flight test may be used, although a ramp test is preferred. The use of an H-14A for ramp-testing is recommended because the use of actual VOR, VAR, or localizer signals may lead to erroneous and unsatisfactory indications. Also, a voice channel on the H-14A makes it possible for the operator of the H-14A to inform the Type 15E operator what test signals are being radiated.

Caution

For all tests, take care to operate the H-14A in accordance with FCC regulations.

Ramp Tests. To test the Type 15E after installation, using the ARC Type H-14A Signal Generator, proceed as follows:

Step 1. Connect the H-14A to an antenna near the airplane and adjust the generator for a simulated VOR signal of, for example, 0° TO.

Step 2. Operate the Type 15E in the aircraft and tune to the test frequency with the control unit's OMNI-VAR LOC switch in the OMNI position. Turn the IN-10 course selector knob to position the pointer at 0°. On the IN-10, the flag alarm over the vertical pointer should be out of sight, the vertical pointer should be centered, and the to-from meter should indicate TO.

Step 3. Observing the vertical pointer on the IN-10, rotate the course selector knob in a clockwise direction until the vertical pointer swings full left and note the course indicator reading. Then rotate the course selector knob in a counterclockwise direction until the vertical pointer swings full right and note the course indicator reading. The difference between the two readings should be 18° to 23°.

Note

Always make this course sensitivity check with the to-from meter in the TO position, otherwise opposite indications will result.

Step 4. Adjust the course selector knob until the ball indicator is at 0°; that is, a 180° reciprocal indication of Step 2. Note that on the IN-10, the flag alarm over the vertical pointer is out of sight, the vertical pointer is centered, and the to-from meter now indicates FROM.

Step 5. Reset the course indicator for a 0° TO course, then gradually change from 0° to 10°, and note the direction of movement of the vertical pointer. It should swing to the left if all connections are correct.

Step 6. As the H-14A operator announces the ANGLE-TO tracks for each 60° around the compass, adjust the course selector knob accordingly, and note that the vertical pointer flag alarm is out of sight, the vertical pointer is centered, and the to-from meter indicates TO for each announcement.

Note

If during the previous tests the vertical pointer, to-from meter, or flag alarm exhibits signs of 30-cycle vibration, the 1000-μf electrolytic capacitors in the E-16, E-17, or E-18 Rack require reforming. Refer to paragraph 5–3.

Step 7. Set the control unit OMNI-VAR LOC switch to the VAR LOC position.

Step 8. As the H-14A operator transmits and announces separate "needle left," "needle center," and "needle right" signals, check that the vertical pointer flag alarm disappears in each case and that the vertical pointer swings first left, near the outer edge of the blue arc; then centers; then swings right, near the outer edge of the yellow arc.

Step 9. During the test signal transmission, check the operation of the volume control and also the quality and available audio level of voice transmission.

Step 10. With the volume control set fully clockwise, strike the top or side of the R-32 and B-13A sharply with the palm of the hand. There should be negligible microphonic noise and no signal interruption or appreciable noise resulting from such blows. Repeat this test with the OMNI-VAR LOC switch in the OMNI position.

Step 11. Turn the equipment off.

Flight Tests.

Note

If an H-14A Signal Generator or equivalent is not available, an in-flight equipment performance check may be made. Due to the difficulty of direct positioning while in flight and the allowable error tolerances of VOR stations, and other factors, an in-flight test is subject to error and should not be relied upon completely as an accurate check of the Type 15E installation.

A flight test of the Type 15E for VOR reception might include flying a straight track toward and over a VOR station from a point 75 miles out, at approximately 6000 feet above the terrain. The flight test will check the sensitivity, course indication steadiness, and the operation of the to-from meter. The course-sensitivity may be checked during the flight by noting the number of degrees shift on the IN-10 required for a full swing of the vertical pointer from the last dot on the left to the last dot on the right; the shift should be between 18° and 23°. Note the bearing for several known locations. Check these against the airways chart, remembering that the IN-10 reads magnetic bearing. Note the movement of the to-from meter while approaching and passing over a station. It should read TO while approaching the station and FROM when the station has been passed. In a limited region above the station (the "cone of confusion"), the readings of both the vertical pointer and the to-from meter will be erratic. Note that when flying on-course toward the station with the to-from meter showing TO, a movement of the vertical pointer to the right or left requires steering right or left respectively to get back on the course. This same steering rule follows in flying on-course away from the station with the to-from meter showing FROM.

A flight check of VAR operation should be made on a VAR airways range if available. A distance check should show normal operation for at least 75 miles, at approximately 6000 feet above the terrain.

A flight check on a 90/150-cycle runway localizer should be made for accuracy and range, and to make certain that a motion of the vertical pointer to the left or right requires steering left or right respectively to get back on course. An on-course indication should lead the airplane directly down the centerline of the runway. The course is necessarily very "tight" on a localizer approach, in order to insure positional accuracy.

2–9. INSTABILITY OF VOR PRESENTATION.

If during either of the post-installation tests described in paragraph 2–8 the cross-pointer meter exhibits instability during VOR reception, it is possible that the use of unshielded wiring to the IN-10 course selector section may be allowing transient voltages to be induced into the wiring between the IN-10 and the rest of the equipment. Transient voltages may also appear if the course selector leads are bundled with power leads, or with leads that may be conducting noise from one part of the airplane to another. To remedy this condition, shield the IN-10 course selector leads and ground the shielding.

SECTION III
OPERATION

3–1. VHF NAVIGATION FACILITIES.

General. The various vhf navigation facilities that can be received and interpreted by the Type 15E are described in the following paragraphs. A comparison of these navigation facilities is given in Table 3–1.

TABLE 3–1. CHARACTERISTICS OF VHF NAVIGATION FACILITIES

Characteristics	VOR	VAR	Localizer
Frequency	108-118 mc	108-110 mc	108-112 mc
Identification (3 letter)	Continuous or voice, or both	Standard interval	Continuous or voice
Aural Track	No	A-N and on-course	No
Visual Track	Yes	Yes	Yes
Voice	Replaces identification when used	Simultaneous	Replaces identification when used

Omnidirectional Ranges (VOR). The vhf omnidirectional ranges (VOR) provide a greater number of available airways courses than the existing standard low-frequency ranges or vhf visual-aural ranges. Theoretically, an infinite number of courses are available, radiating from the VOR transmitter like the spokes of a wheel. In comparison with other available navigation facilities, where both sight and sound are necessary for maintaining a course, VOR navigation depends principally upon the visual indications supplied by a vertical pointer. VOR may be likened to the standard low-frequency range, if there were but one leg whose bearing was under the control of the pilot, and if the on-course indication were given visually by the vertical needle of the cross-pointer meter. In the VOR system, the pilot sets up any track he desires by means of his course selector, and then flies that track by reference to the vertical pointer of his cross-pointer meter.

Visual-Aural Ranges (VAR). The vhf visual-aural range (VAR) facilities provide a course that may be followed by observing the vertical pointer of a cross-pointer meter, and another course that may be followed by listening to the A-N signals, with a continuous tone for on-course. The visual course is usually along the airway and the aural at right angles to the airway. By listening for the A or N signal, and noting whether the vertical needle is in the blue or yellow sector of the cross-pointer meter, the quadrant may be identified by reference to the CAA airways chart. VAR stations are set up according to the pattern listed in Table 3–2.

TABLE 3–2. VAR QUADRANT IDENTIFICATION

Airway	Visual Course[1]		Aural Course[2]	
	Sector of C-P Meter		Aural Signal	
	Yellow	Blue	A	N
Green or Red	South	North	West	East
Amber or Blue	East	West	South	North

[1] Directions north, east, etc. are with respect to the Visual Course.
[2] Directions north, east, etc. are with respect to the Aural Course.

Localizers. For localizers, transmission of two modulations produces a sharp course as indicated by a center reading of the vertical pointer of the cross-pointer meter. A front-course runway approach will result in a center-reading; also, if the needle is to the right of center, the aircraft must move to the right to get on course, and if the needle is to the left of center, the aircraft must move to the left to get on course. If, however, a back-course runway approach is followed, the procedure for centering the needle is reversed.

3–2. VHF COMMUNICATION SYSTEM.

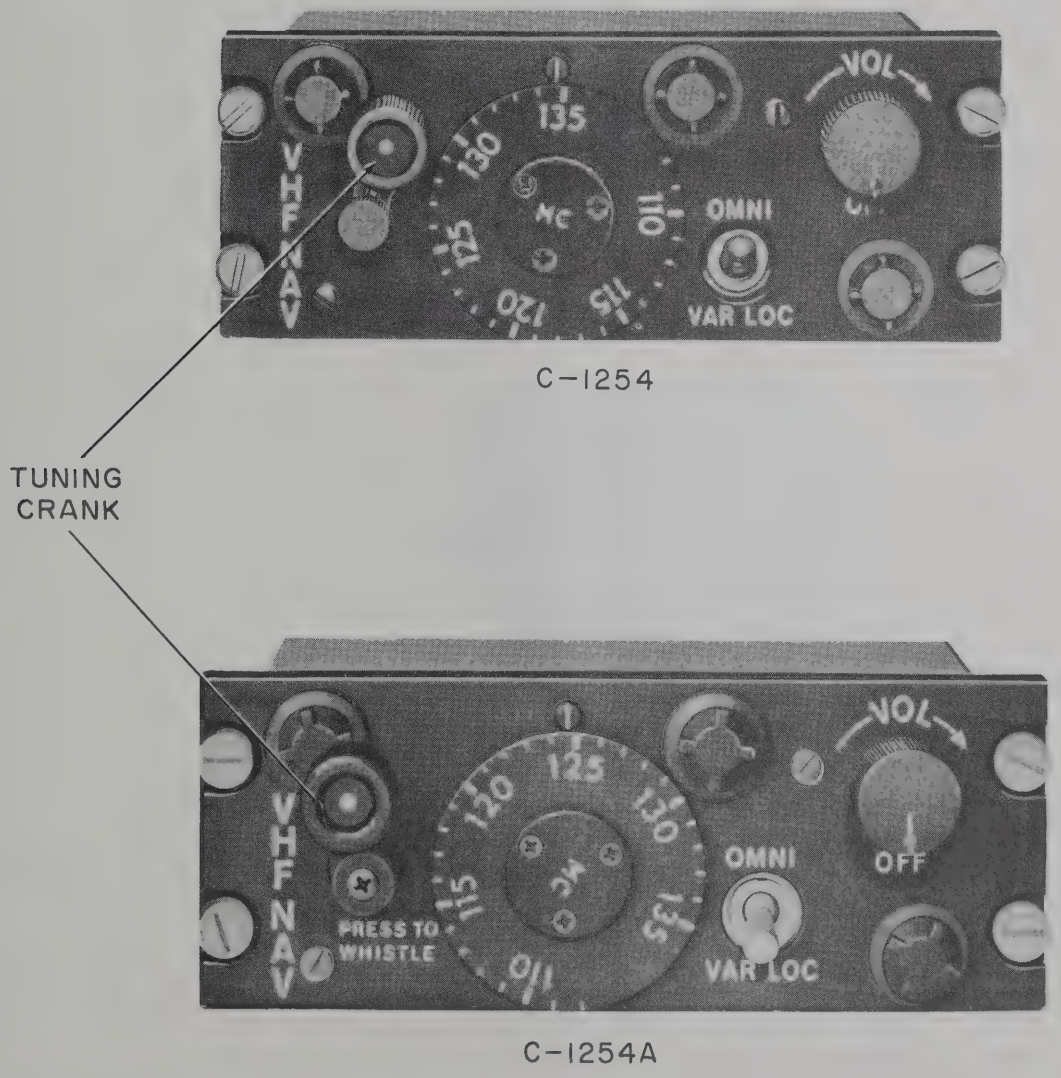
In addition to its navigational uses, the Type 15E can operate as part of a vhf communication system when used with an appropriate ARC transmitter. During such operation the whistle-through tuning feature permits precise tuning of the R-32 Receiver to any one of the transmitter crystal frequencies. Whistle-through tuning is not possible when the C-22A or C-1254 Control Unit is used.

3–3. OPERATING CONTROLS.

All controls necessary for the operation of the Type 15E are located on the control unit and the IN-10 Course Indicator. The locations of these controls are shown in Figures 3–1 and 3–2. Their functions are listed in Table 3–3.

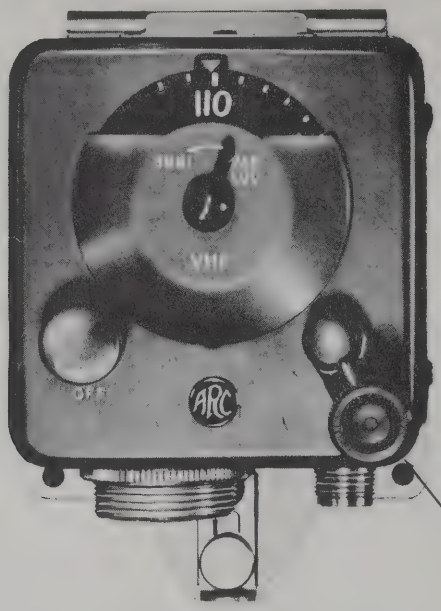
TABLE 3–3. OPERATING CONTROLS

Unit	*Control Designation*	*Function*
C-22A, C-1254, and C-1254A Control Units	VOL-OFF	Combination volume control and on-off switch. Controls application of power to the Type 15E. Clockwise rotation turns power on. Further clockwise rotation increases audio level of R-32 Receiver.
	OMNI-VAR LOC	Function selector switch. In OMNI position, equipment provides track information, as chosen by operator, when tuned to selected VOR station. In VAR LOC position, equipment is set for operation with either VAR or localizer signals.
	Tuning Crank (no panel marking)	Tunes R-32 Receiver remotely through interconnection of mechanical linkage.
	PRESS TO WHISTLE	(Used on C-1254A only.) Provides for precise tuning of R-32 Receiver to any one of transmitter crystal frequencies.
IN-10 Indicator	Course Selector Knob (no panel marking)	Selects or determines magnetic bearing *(not heading)* of aircraft relative to VOR station being received.



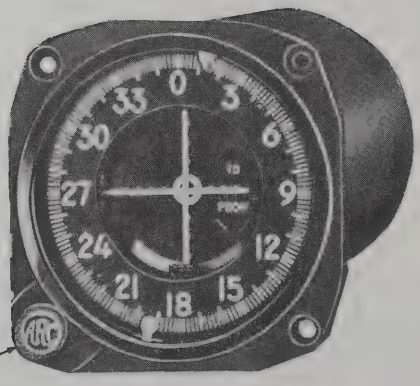
TP1220

Figure 3–1. ARC Type C-1254 and C-1254A Control Units, Operating Controls



C-22A

TUNING
CRANK



IN-10

COURSE
SELECTOR
KNOB

TP1222

Figure 3–2. ARC Type C-22A Control Unit and ARC Type IN-10 Course Indicator, Operating Controls

3–4. VOR OPERATION.

Typical Uses of VOR. The following navigation procedures are typical of those that may be flown using VOR facilities.

1. Determination of aircraft bearing relative to a VOR station
2. Flying a desired track to or from a VOR station
3. Flying to an objective using two VOR stations
4. Approximate ground speed check using two VOR stations
5. Intersecting a localizer using a VOR station
6. Let-down procedure

Principles of Flying VOR. Figure 3–3 illustrates and notes the basic operating principles of flying a VOR range. In this illustration, the to-from meter and vertical pointer indications are shown for several aircraft locations with respect to a selected VOR station, and a course indicator setting of 270°.

Determination of Aircraft Bearing Relative to VOR Station. To determine the bearing of an aircraft relative to a VOR station, proceed as follows:

Step 1. Turn the OFF switch on. Turn the OMNI-VAR LOC switch to OMNI. Allow the equipment to warm up.

Step 2. Tune in the desired VOR station and identify. Make certain that the IN-10 vertical pointer flag alarm is out of sight.

Step 3. Rotate the IN-10 course selector knob until the vertical pointer is centered.

Step 4. Read the IN-10 bearing, which is the magnetic bearing of the aircraft relative to the VOR station, and note whether it is TO or FROM the station as indicated by the to-from meter.

Step 5. The general location of the aircraft with respect to the VOR station may be determined as follows: If, for example, the bearing is "135 TO," the aircraft is northwest of the station; if the bearing is "135 FROM," the aircraft is southeast of the station.

Note

VOR supplies only positional information. The IN-10 does not indicate the heading of the aircraft. See Figure 3–3.

Step 6. To determine the actual position of the aircraft, tune in a second VOR station, and plot its bearing against the bearing of the first VOR station.

Flying a Desired Track To or From a VOR Station. To fly a desired track to or from a VOR station, proceed as follows:

Step 1. Turn the OFF switch on. Turn the OMNI-VAR LOC switch to OMNI. Allow the equipment to warm up.

Step 2. Tune in the desired VOR station and identify. Make certain the IN-10 vertical pointer flag alarm is out of sight.

Step 3. Rotate the course selector knob so that the IN-10 pointer points to the magnetic track it is desired to make good to or from the station. Check that the to-from meter is indicating TO or FROM, depending on the desired direction of flight.

Step 4. Note the position of the vertical pointer and the to-from meter. If the track chosen is *to* the VOR station and the aircraft is less than about 70° from the selected track, the to-from meter will indicate TO. If the track chosen is *from* the station and the aircraft is less than about 70° from the selected track, the to-from meter will indicate FROM. If the aircraft is in the vicinity of 90° from the selected track, the to-from meter will be neutral; that is, no indication will be visible.

Step 5. Check the bearing shown on the IN-10 with the compass heading; they should be in general agreement. If they are, observe the position of the vertical pointer. To position the aircraft on the desired course, "steer toward the needle"; that is, if the pointer is left of center, steer a heading somewhat to the left and hold the chosen heading until the pointer centers; if it is right of center, steer a heading somewhat to the right until the pointer centers. The angle of intercept will depend on the displacement from the desired track. If far off the track (needle hard over), an intercept angle up to 90° may be chosen. If only one or two dots off the track, intercepts of only 5° to 10° are required to get on track. When the pointer is centered, the aircraft is on the selected track. When "flying the needle," do not attempt to keep the pointer directly in the center; rather, fly the general trend of the pointer to prevent over-correction. If the compass heading and the IN-10 bearing are about 180° apart, it indicates that the aircraft is heading in a direction opposite to the desired course. An attempt to "steer into the needle" under this condition will cause the pointer to move still further left or right. To correct the situation, make a 180° turn and then "fly toward the needle."

Note

VOR supplies only position information. Direction or heading information must still be obtained from the compass. The rule of "steer toward the needle" is applicable only if the course indicator bearing and the compass heading are kept in general agreement, and in agreement with the course it is desired to make good.

Flying to an Objective Using Two VOR Stations. The procedure for flying to an objective using two VOR stations is outlined and illustrated in Figure 3–4.

Ground Speed Check Using Two VOR Stations. An approximate ground speed check can be made using two VOR stations. The procedure is outlined and illustrated in Figure 3–5.

Intersection of Localizer Using a VOR Station. The procedure for intersecting a localizer path, using a VOR station, is outlined in Figure 3–6.

Procedure for Let-downs. Let-downs, using VOR, may be made where authorized, in accordance with published information. The required procedures are the same as for flying a desired track to or from a VOR station.

3–5. INDICATIONS OF ARRIVAL OVER VOR STATION.

Upon arrival over a VOR station, the indications on the IN-10 and the aural signal are affected as follows:

1. The aural signal suddenly increases in strength and may become distorted.

2. The vertical pointer on the IN-10 swings abruptly from side to side.

3. The vertical pointer flag alarm may appear and disappear in rapid succession.

4. The to-from meter of the IN-10 becomes erratic, showing TO, then FROM, etc., finally steadying into the FROM position, indicating that the aircraft has passed the VOR station.

3–6. VAR OPERATION.

Note

This type of station is rapidly disappearing; the following information is provided, however, for use where VAR facilities still exist.

Typical Uses of VAR. The following navigation procedures are typical of those that may be flown using VAR facilities:

1. Flying visual courses
2. Flying aural courses
3. Position determination through fixes or quadrants

Principles of Flying VAR. Visual and aural indications that might be observed during a VAR flight are shown in Figure 3–7.

Position Determination. To determine the position of an aircraft, or to fly an on-course heading through the use of the VAR stations, proceed as follows:

Step 1. Turn the OFF switch on. Turn the OMNI-VAR LOC switch to the VAR LOC position. Allow the equipment to warm up.

Step 2. Tune in the desired VAR station and identify. Check that the IN-10 vertical pointer flag alarm is out of sight.

Step 3. Note whether the vertical pointer is in the blue or yellow sector of the IN-10; also, whether the audio is an "A" or an "N." Refer to the area map and determine the quadrant for the aircraft position.

Step 4. If off course and flying the visual course, fly toward the other color sector on the map, not the IN-10 color sector, to get on course. The direction of steering will depend on the quadrant position of the aircraft (see Figure 3–7). A centered vertical pointer indicates the aircraft is on course.

Step 5. If off course and flying the aural course, fly toward the other signal (refer to area map) to get on course. The direction of steering will depend on the quadrant position of the aircraft (see Figure 3–7). A steady aural signal indicates the aircraft is on course.

3–7. LOCALIZER LET-DOWNS.

The procedure for a let-down using localizers, when approaching the runway on the front course, is outlined and illustrated in Figure 3–8. If the approach to the airport follows a localizer back course, follow the procedure described in Figure 3–9.

3–8. SIMULTANEOUS VOICE AND NAVIGATION SIGNAL RECEPTION.

To receive voice and navigation signals simultaneously, tune the receiver to the desired station and increase the volume by means of the control unit's OFF control. The adjustment of the OFF control affects only the audio level; the navigation circuits are unaffected.

3–9. INDICATIONS OF ARRIVAL OVER VAR STATION.

Upon arrival over a VAR station, the audio and visual courses are affected as follows:

1. If flying the visual course, the "A" signal will change to "N," or vice versa.

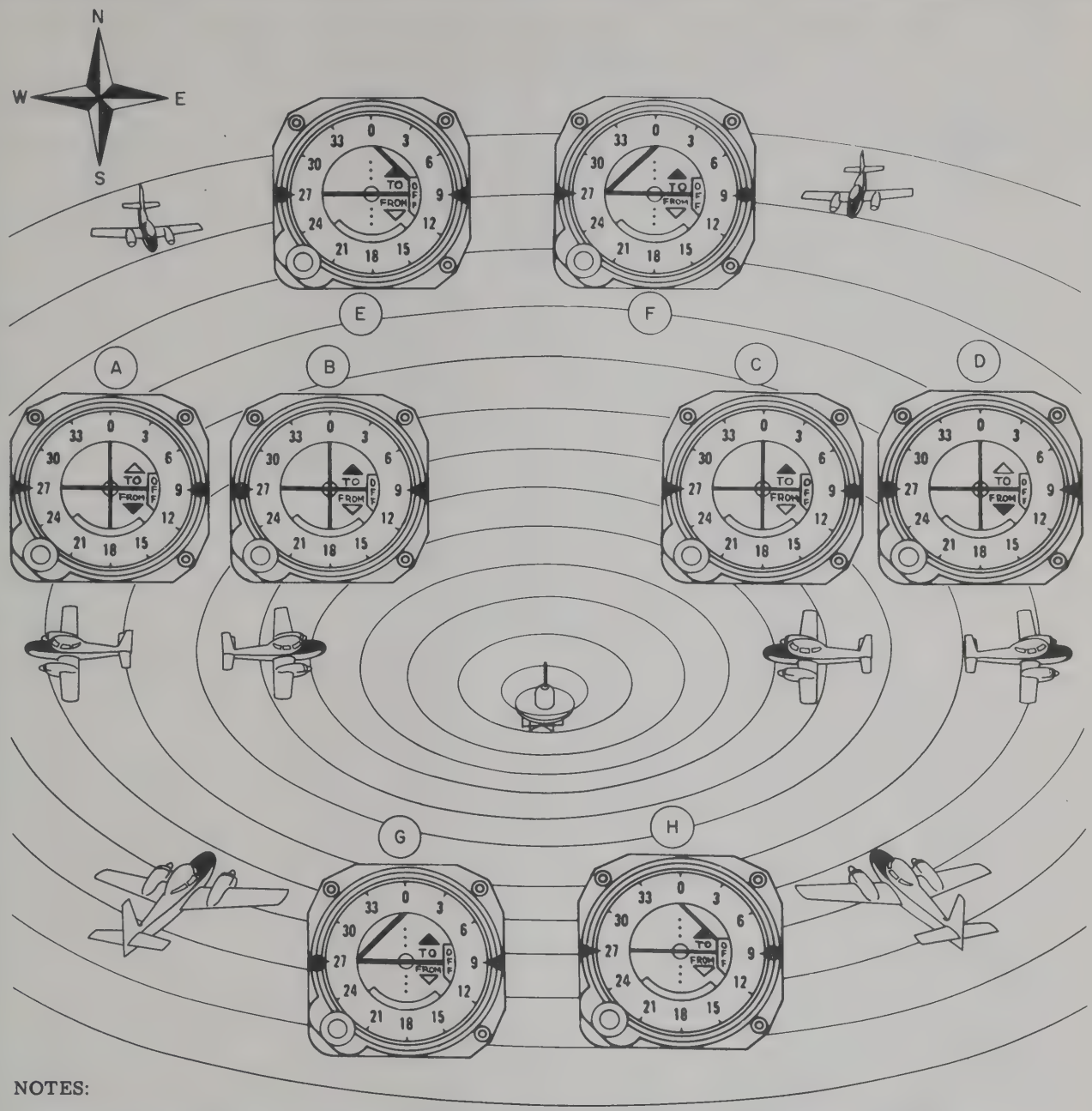
2. If flying the aural course, the vertical needle of the IN-10 will swing from the blue sector to the yellow sector, or vice versa.

3–10. WHISTLE-THROUGH OPERATION OF RECEIVER.

If an ARC transmitter having whistle-through provisions is available, the R-32 Receiver can be precisely tuned to any one of the transmitter crystal frequencies as follows:

1. Set the transmitter to the desired crystal frequency and operate the transmitter (refer to the appropriate transmitter instruction book).

2. Depress the C-1254A Control Unit tuning crank while tuning the receiver for maximum whistle.

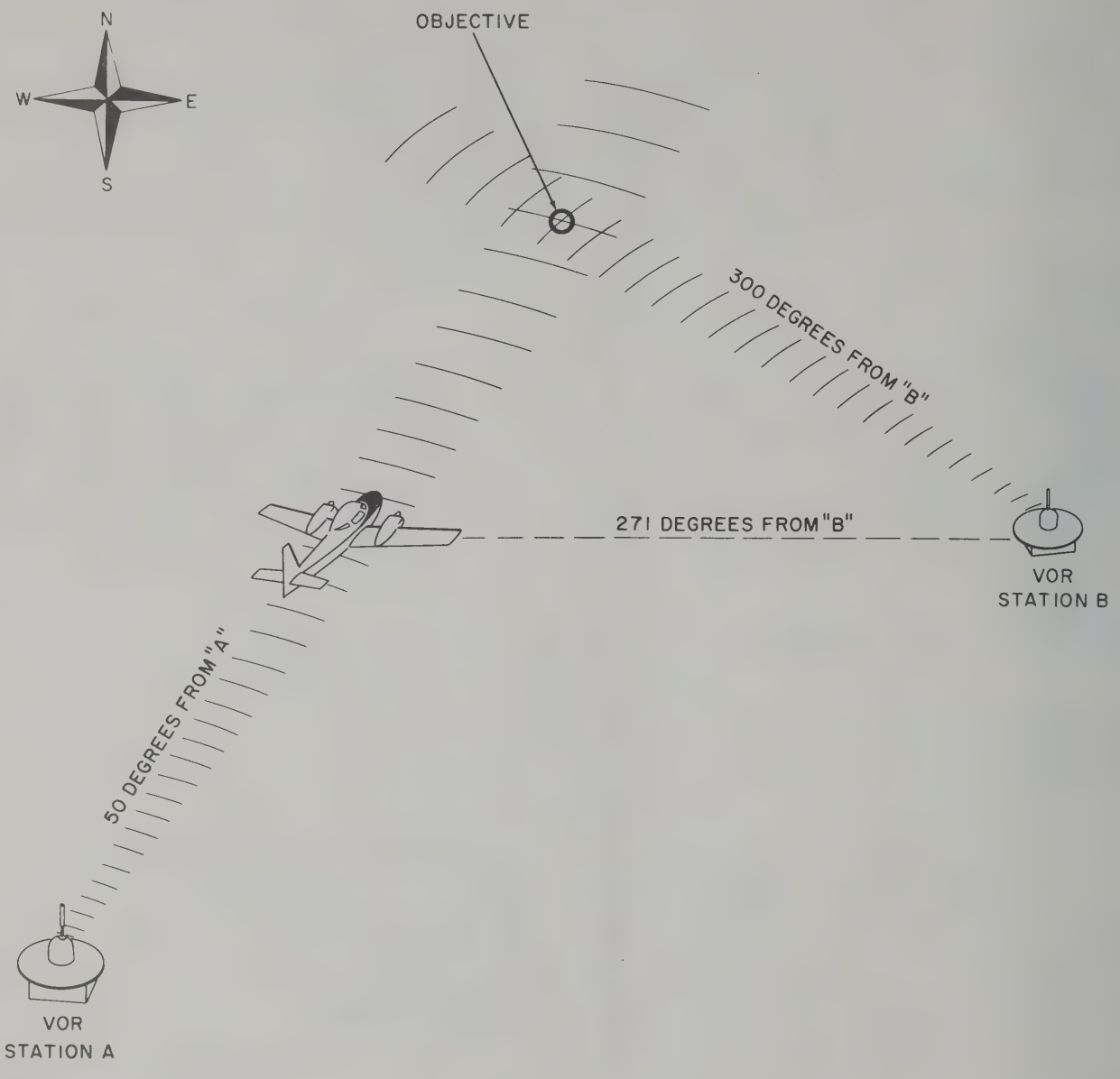


NOTES:

1. It is assumed, for the instrument indications depicted, that in all cases the same VOR station is being received and that in those cases where the IN-10 course indicator has been set to 270 degrees, it is desired to intercept and/or fly to or from the station, depending upon the position of the airplane with respect to the VOR station. The reverse is true when the IN-10 is set to 90 degrees.
2. Note that the vertical pointer is centered for all aircraft on the desired track regardless of direction of flight, or position east or west of the VOR station.
3. Proper VOR flying is shown in positions A, B, C, and D, in accordance with the assumptions of Note 1.
4. Instrument indications at positions E, F, G. and H are shown only for reference purposes. Aircraft considerably off-track to the north or south of the VOR station will experience a "hard-over" vertical pointer position. and the to-from meter will slowly move from one position to the other as the north-south line is passed.

TP1355

Figure 3–3. Instrument Indications During VOR Flight



PROCEDURE:

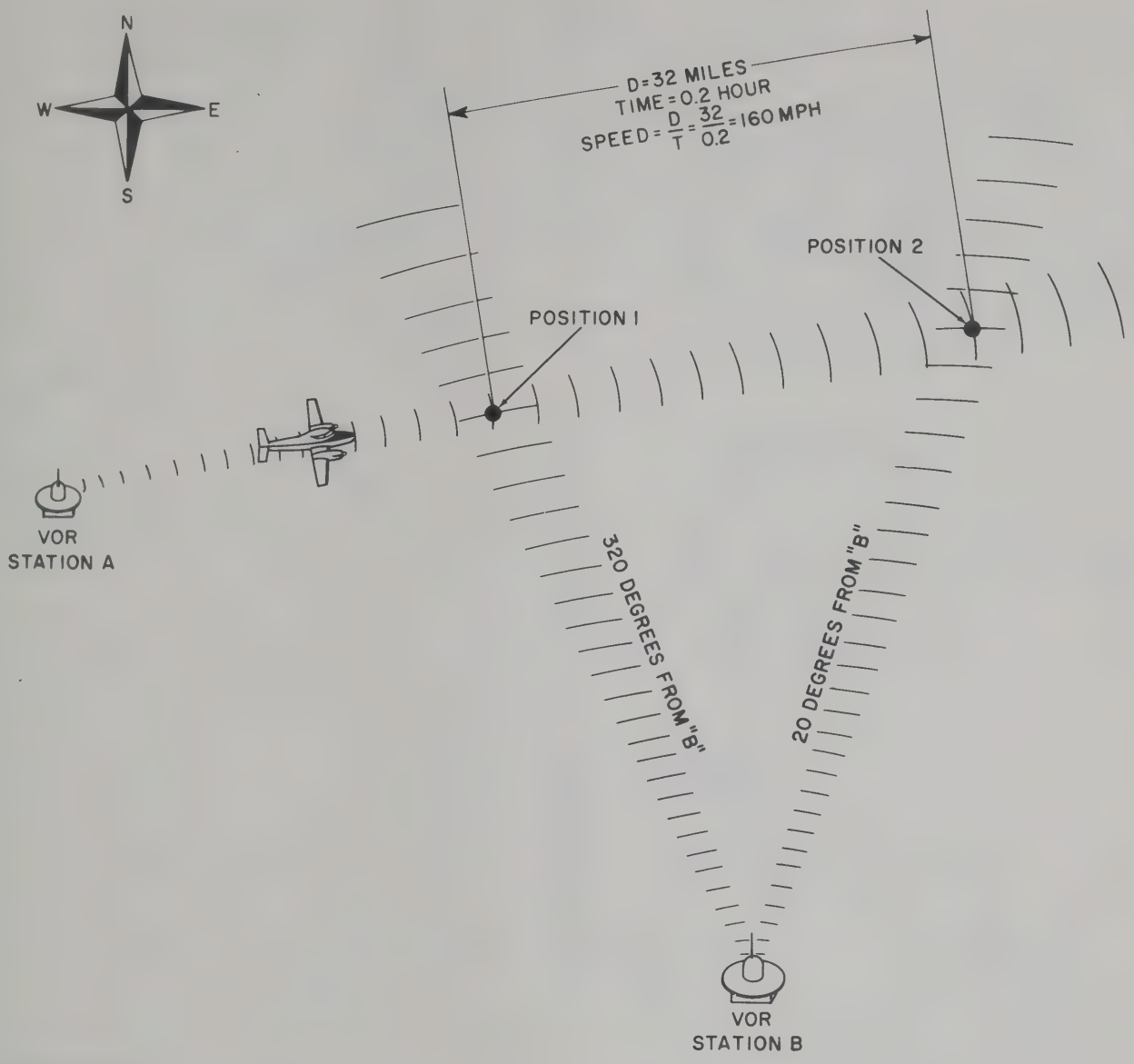
a. Determine magnetic bearing of objective from VOR Station A and then from VOR Station B. As an example, assume that objective lies 50 degrees magnetic from Station A and 300 degrees magnetic from Station B, and that aircraft is near Station A at start of procedure.

b. Operate the Type 15E, as outlined in paragraph 3-4, to fly out on a 50-degree track FROM VOR station A, making all necessary allowances for drift to stay precisely on this track. Note compass heading required to make good this track. Keep this heading, with frequent checks for track accuracy by referring to the IN-10 vertical pointer.

c. Tune in VOR Station B and note bearing from B; at this point it is assumed to be 271 degrees. As this bearing approaches 300 degrees, leave the receiver tuned to B and set the IN-10 course selector to 300 degrees. While still flying the course, as determined by the compass reading of step b., calculated to make good the 50-degrees-FROM-Station A track, note when the IN-10 vertical pointer centers. The aircraft is then over the objective.

TP1357

Figure 3–4. Flying to an Objective Using Two VOR Stations



PROCEDURE:

a. Set and fly a desired course of, for example, 80 degrees FROM VOR Station A, as outlined in paragraph 3-4. The IN-10 course indicator should read 80 degrees, the to-from meter FROM, and the vertical pointer should be centered. The heading of the aircraft as indicated by the compass may differ from 80 degrees due to cross wind, but if the heading is adjusted to keep the pointer centered, the track made good will be 80 degrees FROM. Lay this track out on chart.

b. Tune to VOR Station B and note its bearing with respect to the aircraft. Draw in the measured bearing from VOR Station B. In the example, it is 320 degrees FROM. The intersection will be the position.

c. Check back occasionally on VOR Station A to make sure that the 80-degree-FROM track is being maintained.

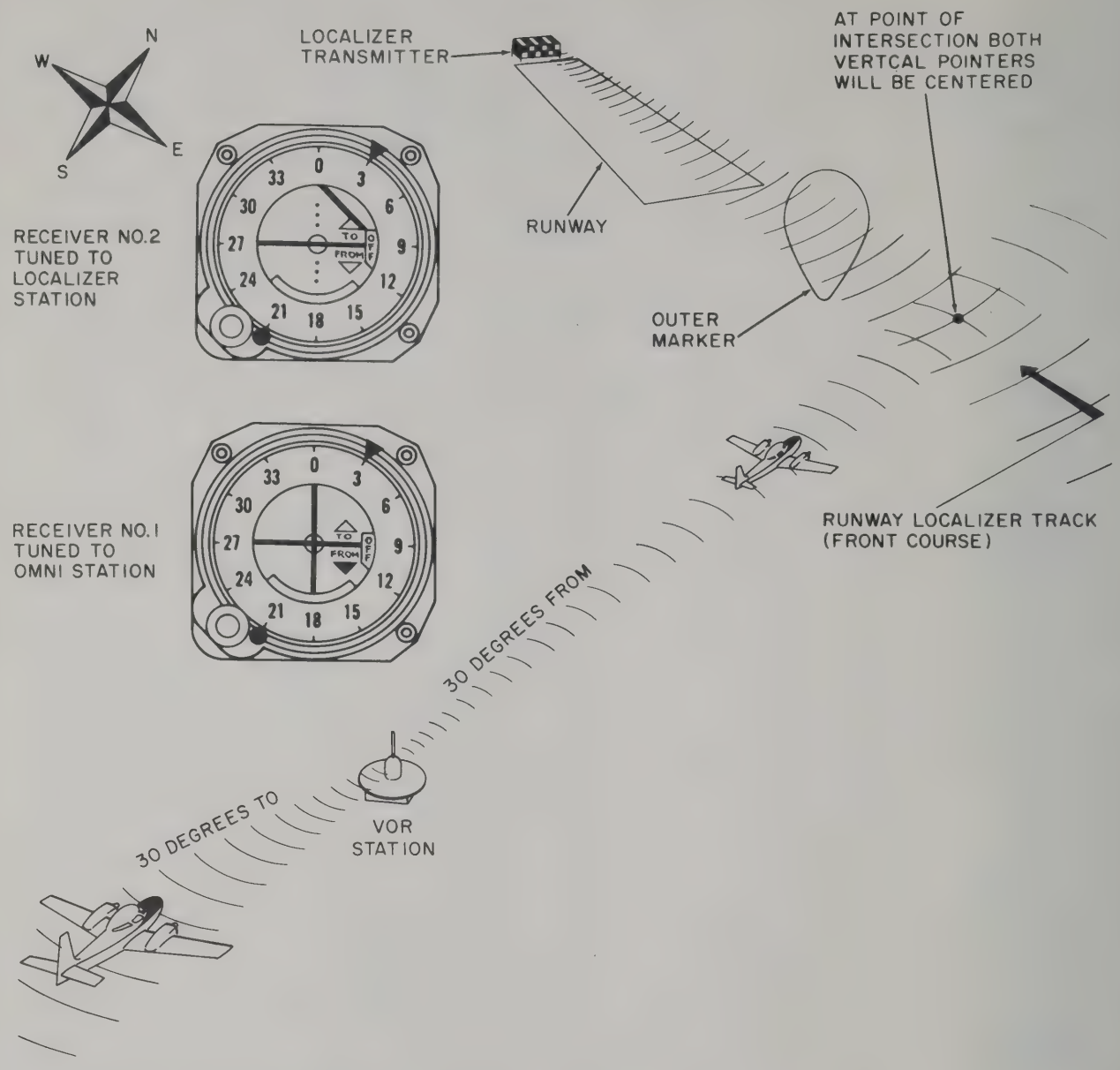
d. After a selected time period has elapsed, for example, 12 minutes (0.2 hour), take a second bearing on VOR Station B. Plot this.

e. Measure the distance D between Position 1 and Position 2.

f. Calculate the speed which is $\frac{D}{T} = \frac{32 \text{ miles}}{0.2 \text{ hour}} = 160$ miles per hour.

TP1359

Figure 3–5. Approximate Ground Speed Check Using Two VOR Stations



PROCEDURE:

a. For the example illustrated it is assumed that the desired point of intersection of the localizer lies 30 degrees magnetic from the VOR station, and the aircraft is southwest of the VOR station. Set and fly the desired course of 30 degrees TO the VOR station. Refer to paragraph 3-4.

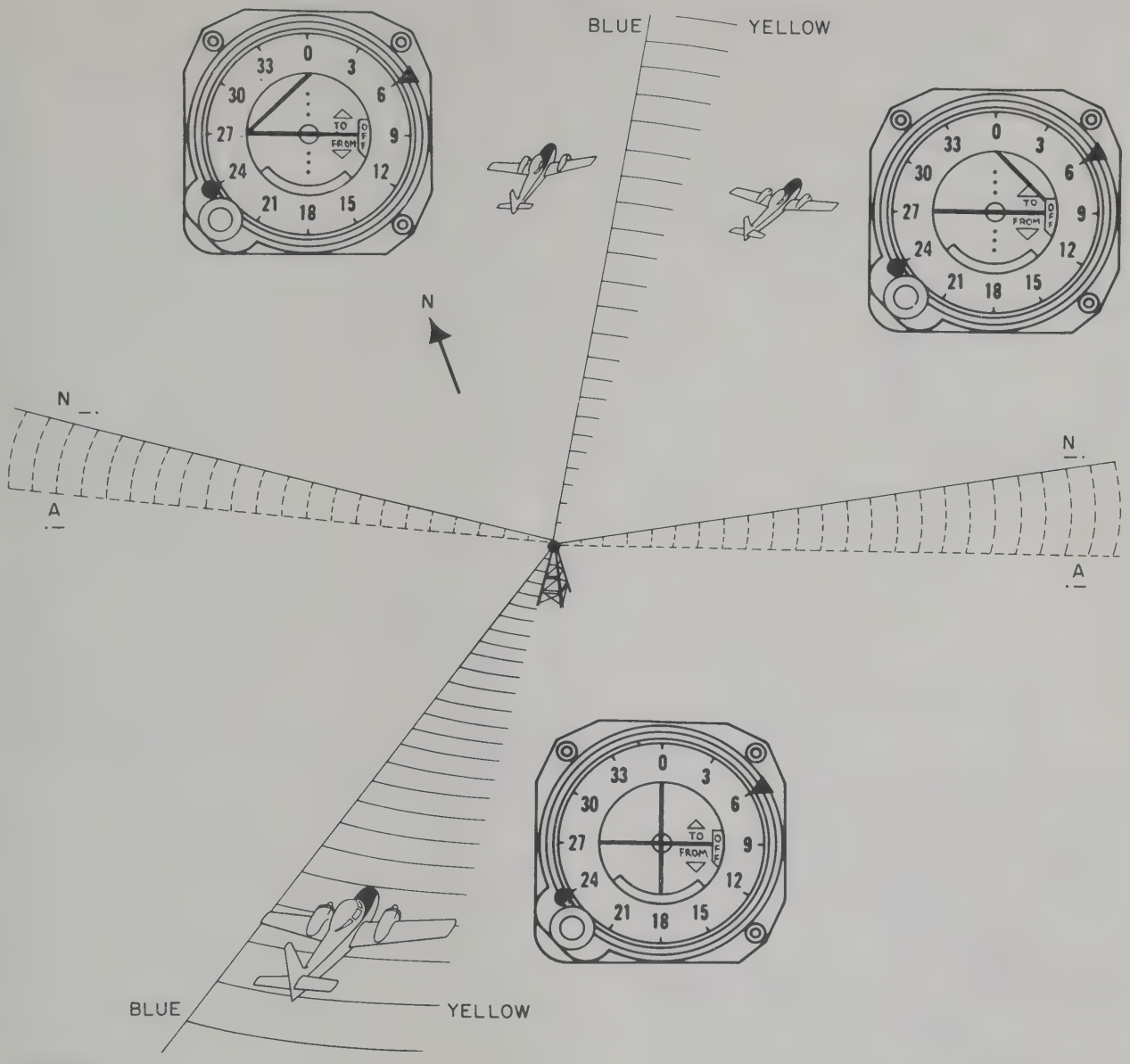
b. Continue to fly this track and pass over the VOR, continuing on the course of 30 degrees FROM. Carefully check the heading of the aircraft to continue this track.

c. Set the control unit OMNI-VAR LOC switch to the VAR LOC position, and tune in the localizer frequency. Identify the localizer station.

d. After tuning in the localizer, the IN-10 vertical pointer will be to the right as the desired intersection point is approached. Intercept localizer as vertical pointer indicates approach to the localizer track.

TP1361

Figure 3–6. Intersection of Localizer Using a VOR Station

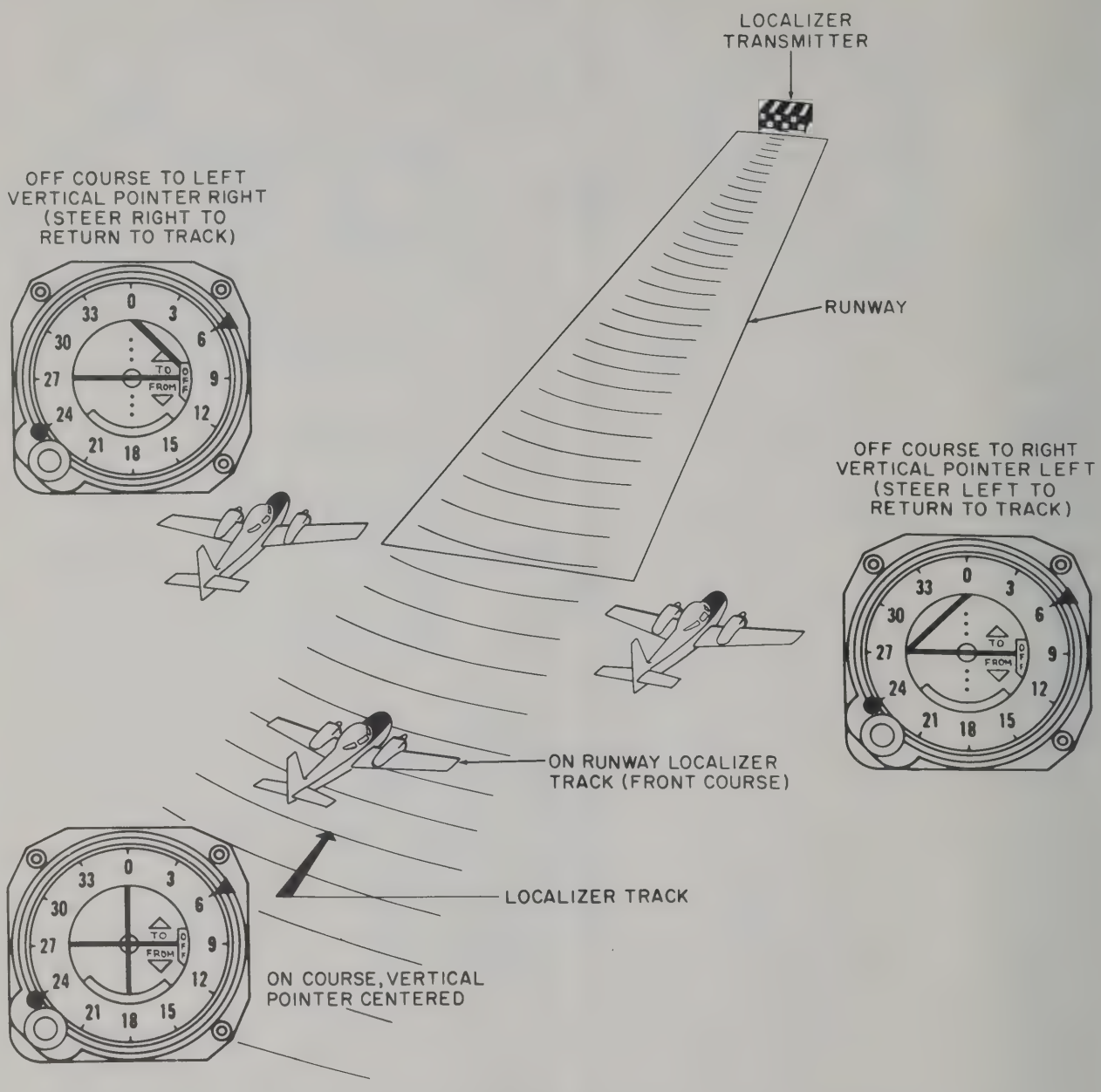


NOTES:

1. VAR ranges have one "visual" leg to the station and one visual leg from the station, as shown. The same station also has "aural" legs as shown. Normally the visual leg is flown making use of the aural signal strictly for quadrant identification.
2. Note that when the aircraft is on-track the IN-10 vertical pointer is in the center. When it is off-track to the right, the pointer swings to the yellow (right). When it is off-track to the left, the pointer swings to the blue (left). When flying in the opposite direction, the indications would be the reverse of the above.
3. The steering rule becomes simple: if you are in a yellow area and wish to get on-track, steer towards the blue sector on the map, not on the IN-10, and vice versa. This rule can be followed whether flying with the blue sector on the left as shown, or in the opposite direction when the blue sector would be on the right. It is therefore not possible to use the same flight rule as in VOR flying of "steer into the needle," because this rule would be correct going in one direction, and incorrect going in the reverse direction.

TP1363

Figure 3–7. Visual and Aural Indications During VAR Flight


LOCALIZER TRANSMITTER
OFF COURSE TO LEFT VERTICAL POINTER RIGHT (STEER RIGHT TO RETURN TO TRACK)
RUNWAY
OFF COURSE TO RIGHT VERTICAL POINTER LEFT (STEER LEFT TO RETURN TO TRACK)
ON RUNWAY LOCALIZER TRACK (FRONT COURSE)
LOCALIZER TRACK
ON COURSE, VERTICAL POINTER CENTERED
TO
FROM
OFF

PROCEDURE:

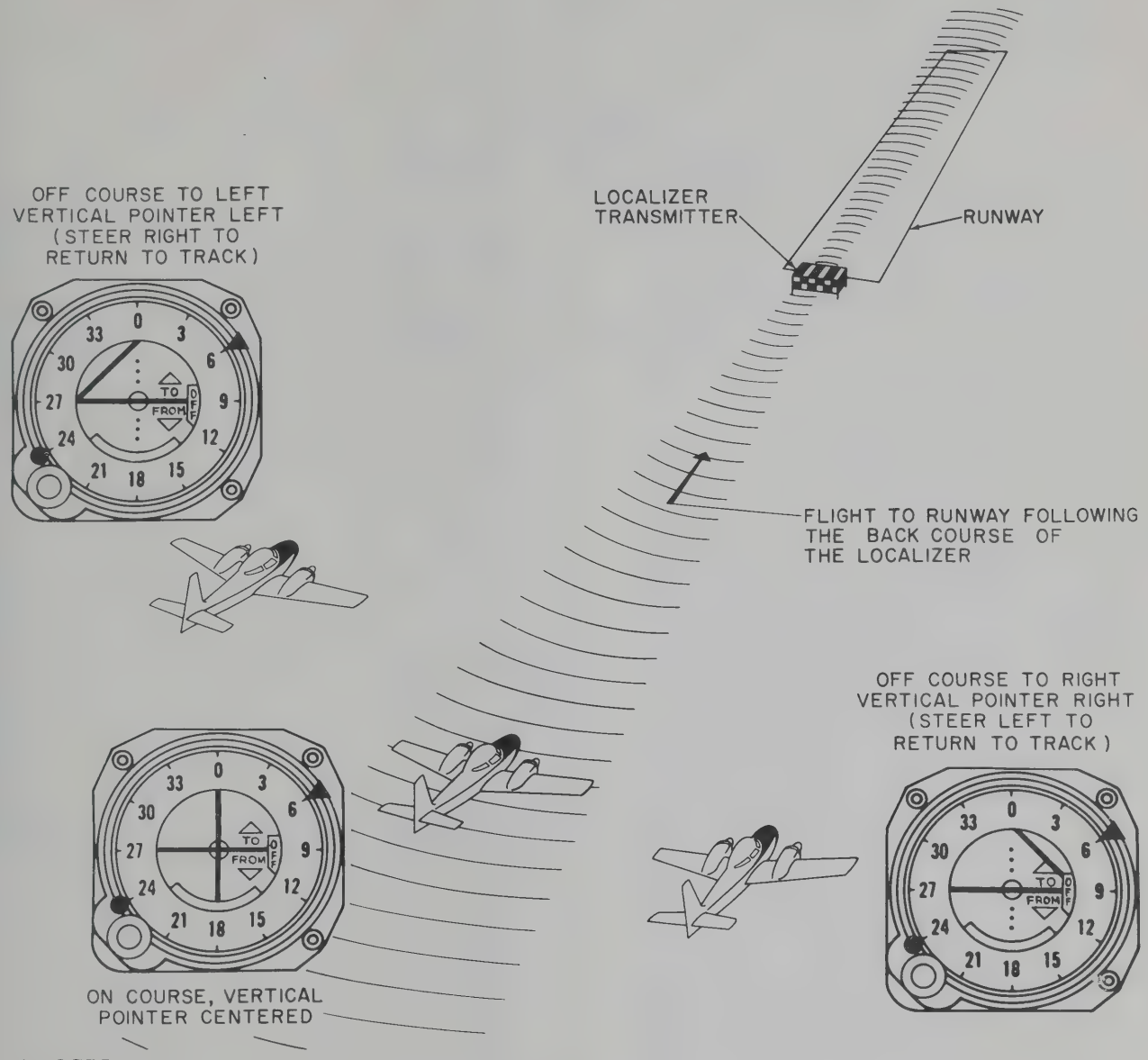
a. Turn the control unit **OFF** switch on. Set the control unit **OMNI-VAR LOC** switch to the **VAR LOC** position. Allow the equipment to warm up.

b. Tune in the localizer signal and identify. Make certain that the **IN-10** vertical pointer flag alarm is out of sight.

c. After the necessary preliminary flight procedures, which should be in accordance with published information for the approach concerned, and on approaching the runway on the front course (inbound), check the position of the vertical pointer. If the pointer reads to the left-of-center, steer left; if to the right-of-center, steer right, to bring the pointer to an on-course center-indication.

TP1365

Figure 3–8. Localizer Instrument Indications, Front Course Runway Approach



PROCEDURE:

a. Turn the control unit OFF switch on. Set the control unit OMNI-VAR LOC switch to the VAR LOC position. Allow the equipment to warm up.

b. Tune in the localizer signal and identify. Make certain that the IN-10 vertical-pointer flag alarm is out of sight.

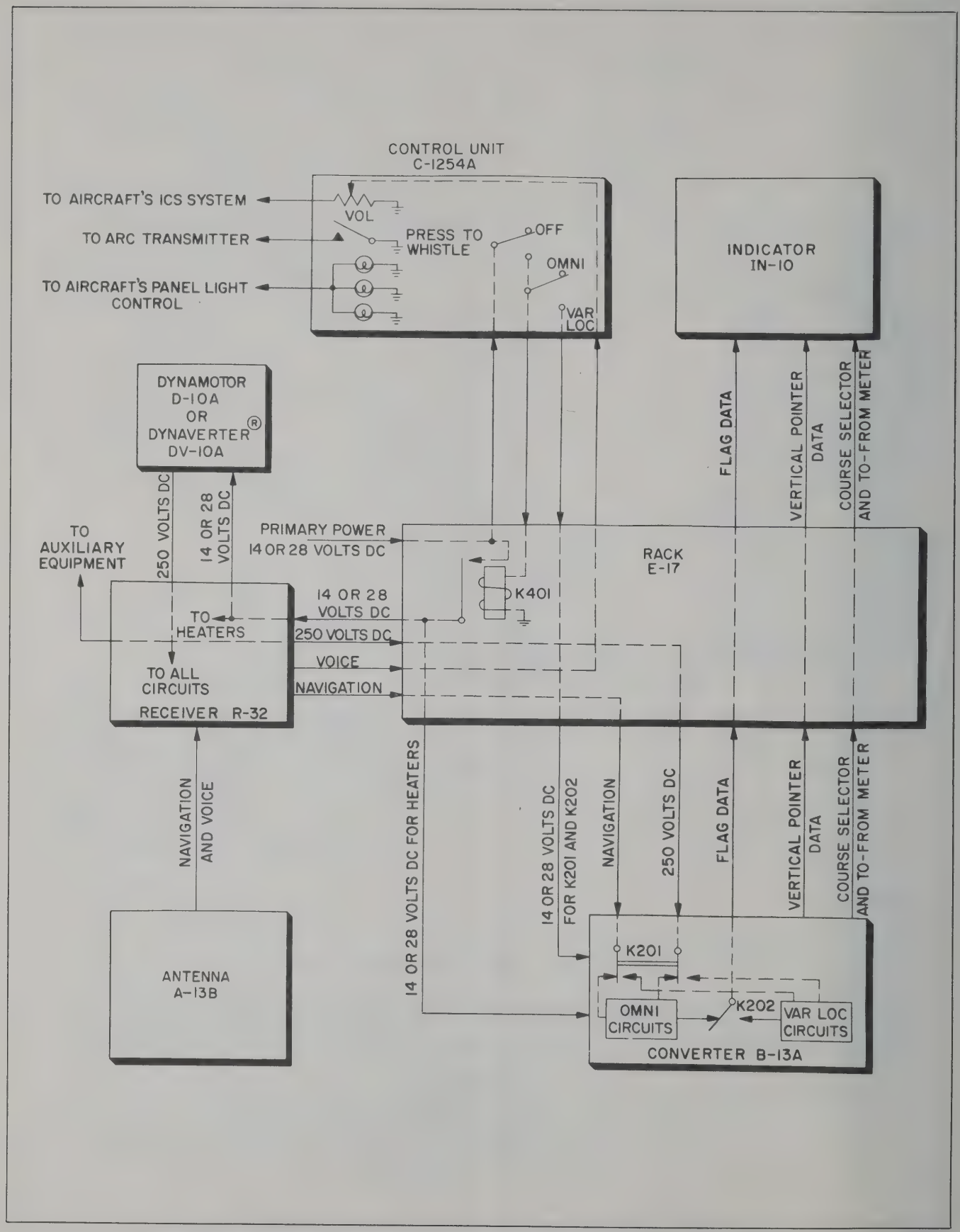
c. After the necessary preliminary flight procedures, which should be in accordance with published information, check the position of the vertical pointer. If the pointer reads to the left-of-center, steer right; if to the right-of-center, steer left. An on-course indication will be verified when the needle is centered.

CAUTION

Note that the back-course approach rule is opposite to the front course approach rule. (See Figure 3-8.)

TP1367

Figure 3–9. Localizer Instrument Indications, Back Course Runway Approach



TP1369

Figure 4–1. ARC Type 15E Equipment, One-Rack Installation, Block Diagram

SECTION IV
THEORY OF OPERATION

4–1. INTRODUCTION.

The Type 15E receives, interprets, and indicates aircraft navigation data. It is also capable of operating as the receiving end of a vhf communication system. The types of navigation information that the Type 15E can receive are VOR (omni), VAR, and runway localizers.

VOR (Omni). The signal transmitted by a VOR station consists of two independent components. The phase of one of these is a function of the bearing from the transmitter; the phase of the other is fixed with respect to magnetic north at the station. For signals received north (magnetic) of a VOR station, the two signal components are in phase. At all other points around the transmitter, they differ in phase according to the receiving antenna's bearing from the transmitter. When operating on VOR, the Type 15E receives these two signal components, detects their phase difference, and indicates the aircraft's bearing from the transmitter on the IN-10 Course Indicator.

VAR. The signals from a VAR station effectively divide the region around the station into four quadrants by means of A-N signals and 90/150-cps signals. Each quadrant contains a unique pair of these four signals. When operating on VAR, the Type 15E feeds the A or N to an audio output, and sends a d-c current, proportional to the difference between the 90- and 150-cps signal, to the IN-10. These visual and aural signals indicate which quadrant the aircraft is in.

Runway Localizers. Runway localizers use 90/150-cps modulation signals. On the track of a proper runway approach, these two modulations are equal in strength. On either side of the runway centerline, one signal is stronger than the other. When operating on a runway localizer, the Type 15E rectifies and compares the 90- and 150-cps signals and feeds a d-c current proportional to the difference in amplitude of these signals to the IN-10. If the aircraft is making its runway approach properly, the two equal signals center the indicator reading. If the aircraft is off course during a front-course approach, however, the stronger signal will cause the indicator to read off center by an amount determined by the displacement of the aircraft from the desired track. If the needle deflects to the right, the aircraft is to the left of the proper path and a correction to the right must be made.

4–2. OVERALL FUNCTIONAL DESCRIPTION.

A simplified block diagram of a one-rack Type 15E installation is shown in Figure 4–1. A detailed block diagram is shown in Figure 4–2. Primary power for the Type 15E is brought in through the E-17 Rack to the C-1254A Control Unit. Either the C-1254 or the C-22A Control Unit may also be used. With the closing of the primary power switch in the control unit, relay K401 in the E-17 Rack is energized. This distributes the low voltage to the filament circuits of the R-32 Receiver and B-13A Converter. The low voltage is also applied through the R-32 to the D-10A Dynamotor or DV-10A Dynaverter for generation of the high-voltage operating potential. The high voltage is distributed to the R-32 circuits, and through the E-17 Rack to the B-13A circuits. If the C-1254A or C-1254 Control Unit is installed, power for the panel lamps is supplied through a separate lead from the aircraft's low-voltage supply.

With the R-32 tuned to an incoming signal by the control unit, the signal picked up by the antenna is fed by coaxial cable to the input circuits of the R-32. The type of signal reception desired is selected by the OMNI-VAR LOC switch on the control unit. With this switch in the OMNI position, the high voltage and the navigation portion of the VOR signal are fed through the E-17 Rack to the normally closed contacts of relay K201 in the B-13A, and to the VOR circuits of the B-13A where the signal is converted into visual track information for presentation on the IN-10. With the switch in the VAR LOC position, a low-voltage circuit is closed, actuating relays K201 and K202 in the B-13A. The closing of K201 applies high voltage to the B-13A, and feeds the navigation portion of the VAR or localizer signal to the VAR and localizer circuits of the B-13A, which convert it for visual presentation on the crosspointer section of the IN-10. The closing of K202 feeds flag data from the VAR and localizer circuits to the flag circuits of the IN-10. If the OMNI-VAR LOC switch is set incorrectly for the type of signal being received, the vertical pointer flag alarm will show. In either position of the selector switch, the audio portion of the received signal is routed through the E-17 Rack to the control unit. When the tuning crank on the C-1254A Control Unit is depressed, a press-to-whistle circuit between the C-1254A and the ARC transmitter is closed.

4–3. A-13B ANTENNA.

The ARC Type A-13B Antenna is a rams horn type incorporating two dipole antennas. The forward dipole can be used for glide slope signal reception, if such equipment is installed in the aircraft. The V-shaped rear dipole is used for reception of all other signals. Both antennas terminate in individual UG-291/U coaxial connectors located in the antenna base.

4–4. R-32 RECEIVER.

The ARC Type R-32 Receiver is a nine-tube superheterodyne, continuously tunable over a frequency range of 108 to 135 mc. A block diagram of the R-32 is shown in Figure 4–3, and its schematic diagram is shown in Figure 6–1. The r-f section of the R-32 is a preselector unit containing four tuned circuits and four electron tubes, arranged as follows: a tuned input circuit; a type 9003 first r-f amplifier and tuned output circuit; a 9003 second r-f amplifier and tuned output circuit; a 9003 mixer; and a 9002 r-f oscillator and tuned circuit. The r-f oscillator and r-f signal circuits are tuned by a four-section gang capacitor. The i-f section, at a frequency of 15 mc, consists of eight i-f tuned circuits; a type 14A7 first i-f amplifier; a 14R7 second i-f amplifier; a 14R7 third i-f amplifier; and a 14F7 detector and noise limiter stage, which also functions as the first audio amplifier. Avc is derived from the second and third i-f amplifiers. The output of the first audio amplifier is coupled to the final audio amplifier, a type 12A6. The output of the 12A6 is fed through a step-down transformer to the telephone load.

There are two audio output lines from the R-32. Navigational signals are taken from the cathode of the first audio amplifier and fed to the B-13A Converter through the E-17 Rack. This output is unaffected by the headset load or setting of the volume control on the control unit. Voice and communication signals reach the headset from the second audio amplifier.

R-f Preselector. The r-f preselector, Z101, consists of the antenna input circuit, the first r-f amplifier, the second r-f amplifier, and the r-f oscillator and mixer circuits.

ANTENNA INPUT CIRCUIT. The antenna input circuit is the first r-f tuned circuit. The signal from the A-13B Antenna is transferred through RG-58/U coaxial cable of 53 ohms nominal impedance to J101, through J101 to the untuned primary coil, L102, and then by inductive coupling to L101. Inductive coupling is chosen to reduce the possibility of any undesired output from r-f oscillator V104 appearing on the antenna. Gang trimmer capacitors C102B, C102D, C102F, and C102G are used to align all tuned circuits using a preselector alignment frequency of 131 mc. C103 is the grid coupling capacitor.

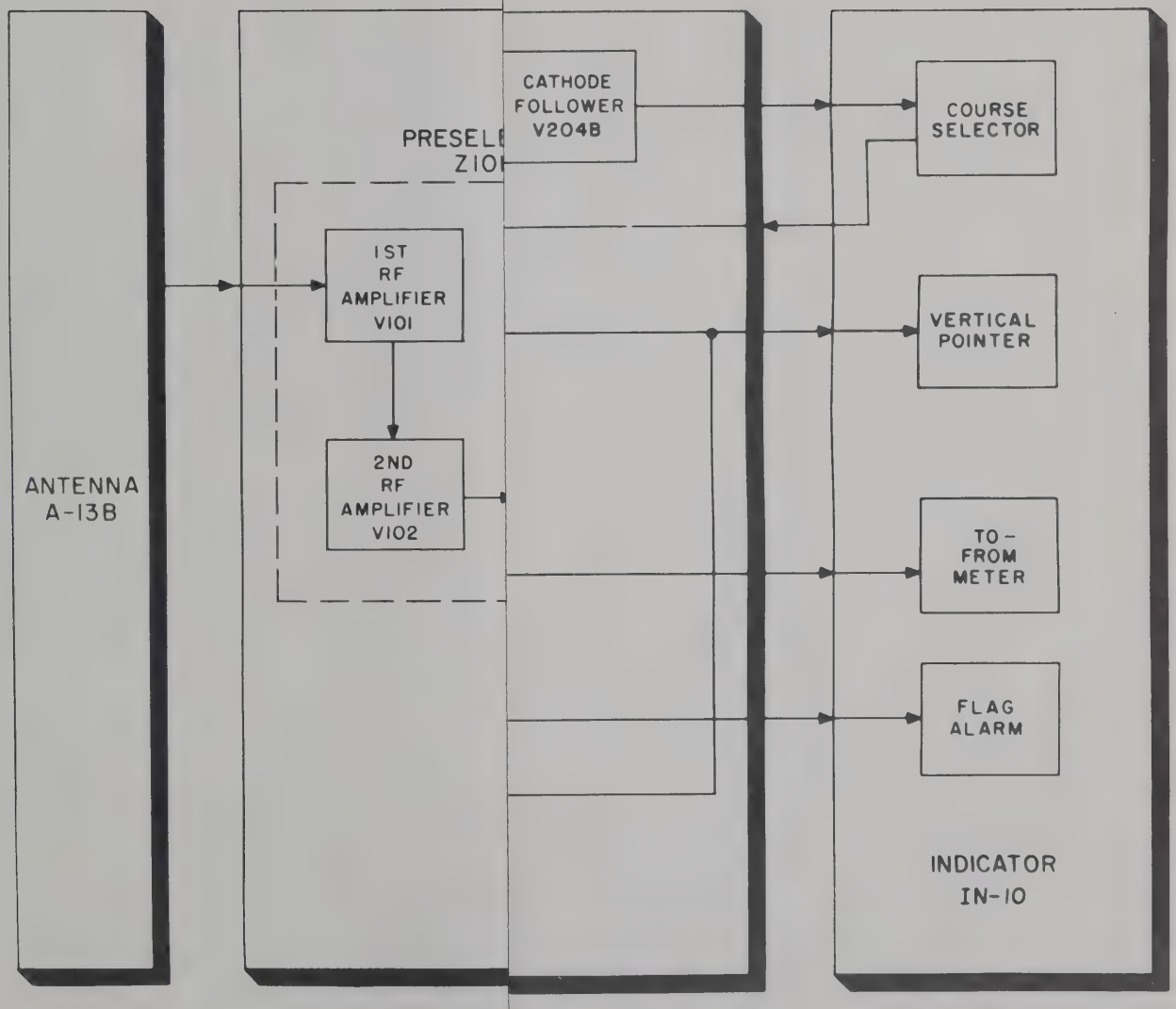
FIRST R-F AMPLIFIER. The r-f signal is coupled to the grid of V101 through C103. R101 provides a d-c connection to the grid bias source. R102 is the cathode bias resistor and C105 is the r-f bypass capacitor. C104 is the grid bias circuit bypass capacitor. C107 with R106 and C111 form a filter network to decouple the plate voltage circuit. Trimmer capacitor C102D is used in aligning the output r-f tuned circuit of V101, which is composed of L103 and C102C. The output of this tuned circuit is coupled to the input grid of V102 through C108.

SECOND R-F AMPLIFIER. The detail parts of the second r-f amplifier function the same as those of the first r-f amplifier. The output of the second r-f amplifier, V102, is applied to the control grid of V103, the mixer.

R-F OSCILLATOR AND MIXER. V104, a type 9002 electron tube, serves as the r-f oscillator in a tuned-plate oscillator circuit. The r-f oscillator frequency is below the signal frequency by 15 mc (the intermediate frequency) throughout the tuning range of the R-32. C102G is the r-f oscillator tuning section of the gang capacitor. C102H is used to align the r-f oscillator tuned circuit, composed of C102G and L106, using an r-f preselector alignment frequency of 131 mc. C117 and R112 are the grid capacitor and resistor. The r-f oscillator voltage is injected by way of coupling coil L105 into the cathode of mixer V103, a type 9003, so that the total r-f grid-to-cathode voltage of V103 is the sum of the signal voltage applied between grid and ground, and the oscillator voltage applied between cathode and ground. All tuned inductances of the preselector are factory-adjusted at the low-end alignment frequency of 111 mc by means of copper slugs mounted in the ends of the coil shields.

I-f Amplifiers. All i-f amplifier circuits are similar in design and function, except for the fourth i-f coupling unit. The i-f amplifier section consists of eight tuned circuits arranged in four pairs. The primary of the first i-f tuned circuit, Z102, is fed from the plate of mixer V103 and consists of L107, fixed capacitor C120, and trimmer capacitor C118. The secondary is similarly designed. The remaining i-f tuned circuits, Z103, Z104, and Z105, except for primary coil L116 and primary and secondary fixed capacitors C152 and C154 of Z105, are identical. L116 is made larger and C152 is reduced in order to obtain sufficient undistorted i-f power for the avc rectifier. C154 is increased to make up for the lower input capacitance of V109. The inductances of each pair of tuned circuits are magnetically coupled and designed to provide almost critical coupling. The output of the seventh i-f tuned circuit is connected to the avc diode of V108; and the output of the eighth i-f tuned circuit, to the detector diode section of V109.

Detector, Noise Limiter, and First Audio Amplifier. The first triode section of V109 is connected as a diode to detect the i-f output from L117 of Z105. It develops a d-c voltage varying at an audio rate across R142 and R143.



TP1375

Figure 4–2. ARC Type 15E Equipment, One-Rack Installation, Detail Block Diagram

4–3. A-13B ANTENNA.

The ARC Type A-13B Antenna is a rams horn type incorporating two dipole antennas. The forward dipole can be used for glide slope signal reception, if such equipment is installed in the aircraft. The V-shaped rear dipole is used for reception of all other signals. Both antennas terminate in individual UG-291/U coaxial connectors located in the antenna base.

4–4. R-32 RECEIVER.

The ARC Type R-32 Receiver is a nine-tube superheterodyne, continuously tunable over a frequency range of 108 to 135 mc. A block diagram of the R-32 is shown in Figure 4–3, and its schematic diagram is shown in Figure 6–1. The r-f section of the R-32 is a preselector unit containing four tuned circuits and four electron tubes, arranged as follows: a tuned input circuit; a type 9003 first r-f amplifier and tuned output circuit; a 9003 second r-f amplifier and tuned output circuit; a 9003 mixer; and a 9002 r-f oscillator and tuned circuit. The r-f oscillator and r-f signal circuits are tuned by a four-section gang capacitor. The i-f section, at a frequency of 15 mc, consists of eight i-f tuned circuits; a type 14A7 first i-f amplifier; a 14R7 second i-f amplifier; a 14R7 third i-f amplifier; and a 14F7 detector and noise limiter stage, which also functions as the first audio amplifier. Avc is derived from the second and third i-f amplifiers. The output of the first audio amplifier is coupled to the final audio amplifier, a type 12A6. The output of the 12A6 is fed through a step-down transformer to the telephone load.

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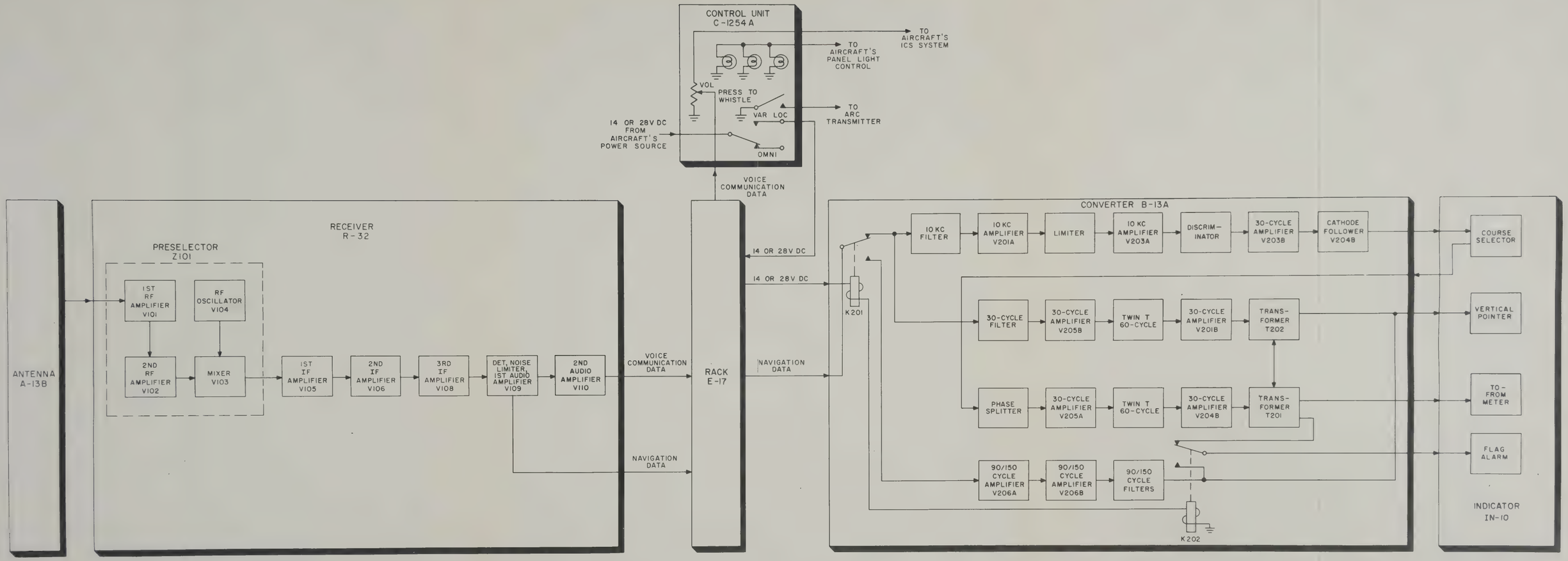
Detector, Noise Limiter, and First Audio Amplifier. The first triode section of V109 is connected as a diode to detect the i-f output from L117 of Z105. It develops a d-c voltage varying at an audio rate across R142 and R143.



TP1375

Figure 4–2. ARC Type 15E Equipment, One-Rack Installation, Detail Block Diagram

The junction of R140 and C155 is kept at ground potential for direct current only by R140 and R141. The junction of R142 and C153B,C is kept at ground potential for audio only by C153B,C. Increasing the i-f amplitude on the detector makes the junction of R142 and C153B,C go positive with respect to ground for direct current and, proportionately, to a lesser extent, does the same for the junction of R142 and R143, whether or not modulation is present. The d-c potential at the junction of R140 and C155 is not affected. If the intermediate frequency is modulated, the potential at the junction of R140 and C155 goes equally positive, at the valley of the modulation envelope, and negative, at the peaks of the modulation envelope. Therefore, the potential at the junction of R142 and R143 goes proportionately positive and negative with respect to the positive d-c (average) potential established at this junction by the i-f carrier level. The potential at the junction of R142 and C153B,C is not affected by modulation.

The second triode section of V109 is biased just to cutoff by the d-c bleeder current from the plus 250-volt supply through R145 and cathode bias resistors R146 and R147; the grid is at ground potential for direct current with no signal on the detector. Therefore, an increasing i-f detector level will place an increasing positive d-c potential on the grid, causing the triode to conduct and plate current to flow. It can be seen that this triode can amplify an audio signal impressed on the grid provided the negative going potential at the junction of R142 and R143 does not instantaneously go more negative than ground. Due to this action, high peaks of the modulation envelope noise peaks of short duration) will not appear in the plate circuit of the audio amplifier.

Second Audio Amplifier. The audio output from V109 is applied to the grid of V110, a type 12A6, for further amplification. The output of V110 is applied to T101, an 8-to-1 output transformer. C163 across the primary of T101 acts as a filter capacitor to attenuate undesired audio frequencies above approximately 4000 cycles, and also to prevent r-f and i-f from getting in or out of the receiver by means of the TEL line. TY101, a thyrite resistor, is also connected across the primary winding of T101. It acts as a surge voltage arrester to protect the equipment if exceptionally strong signals are received when the normal telephone load is removed. Any increase in voltage across the resistor causes a relatively large increase in current through the resistor which tends to limit the voltage to approximately 120 volts ac across the primary of T101.

Automatic Volume Control. Automatic volume control of the R-32 is provided by a biasing circuit comprising the avc diode rectifier (terminal 3 to cathode) of V108; the avc diode clamp (terminal 3 to cathode) of V106; a filter circuit consisting of R137, C144A,B, R124, C122A,B, R116, and C104; and a stabilized source of delayed bias voltage comprising R132, V107, and R130. Since it is not advisable to apply the full value of avc bias to the input grid of V106, a voltage divider circuit consisting of R121 and R122 is included, which permits approximately $\frac{3}{13}$ of the total avc bias to be applied to V106. The i-f voltage to operate the diode rectifier of V108 is obtained from the primary of Z105 rather than the secondary, so that the audio output is sharply tunable, even on a radio signal strong enough to operate the avc, by simply tuning for maximum audio output. If the avc rectifier were operated from the secondary of Z105, the tuning of a strong signal would be so broad that an accurate aural setting would be nearly impossible. The method used eliminates the need for a tuning meter or tuning eye when tuning in strong voice-modulated signals.

Delayed avc action is obtained from the circuits associated with the avc diode rectifier of V108 and with the avc diode clamp of V106. The cathode of V108 is approximately 6 volts positive with respect to ground, due to cathode current through R135. The cathode of V106

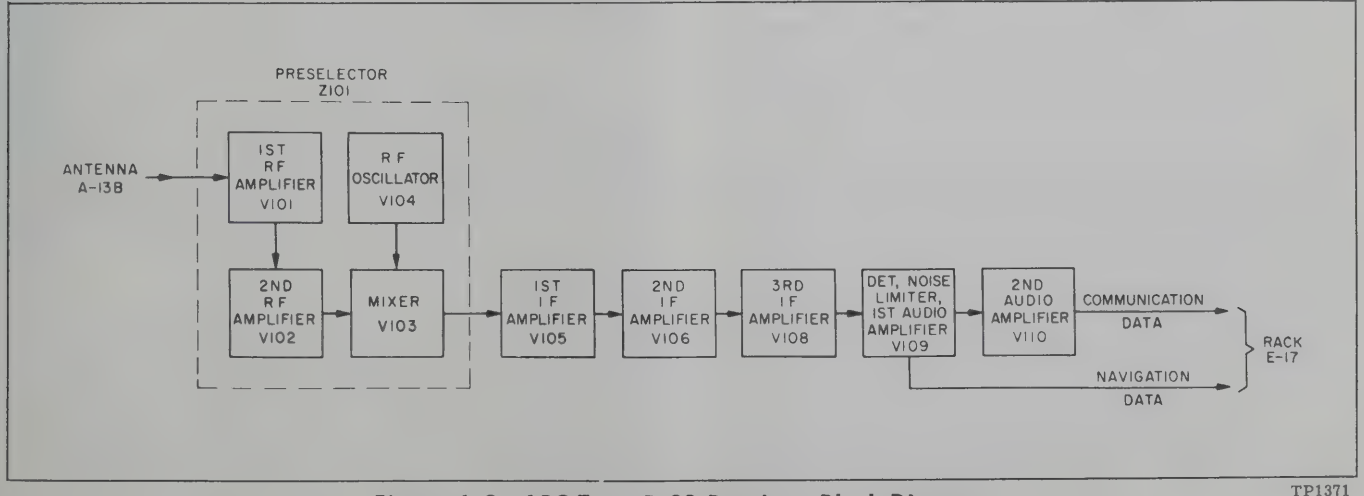


Figure 4–3. ARC Type R-32 Receiver, Block Diagram

is approximately 2.5 volts positive with respect to ground, due to the cathode current through R123. Therefore, with no signal (and no rectification) present in the diode circuit of V108, a net d-c potential of approximately 3.5 volts operates to drive a direct current through R136 and R137 to terminal 3 of V106, producing a negligibly small delay bias of approximately 0.5 volt on V108 by the drop in R136. The delayed bias voltage source operates to provide additional d-c current through the diode of V106 as follows: Resistor R132 and neon lamp V107, fed from the plus-260-volt high-voltage source, serve to produce a stable d-c potential of approximately 80 volts at the junction of R132 and R130. As a result, an additional d-c current will flow through R130 to terminal 3 of V106, but with no effect on the no-signal potential of the avc bias line. The d-c voltage drop through the low resistance of the diode clamp is negligible, and the d-c potential of the avc bias line to the grids of V101, V102, and V105 is held at the same potential as the cathode of V106.

In order to cause the potential of the avc bias line to become more negative, to start avc action, the i-f signal level present must be of sufficient magnitude to cause the diode rectifier (terminal 3 of V108) to become so negative that all of the d-c current through R130 flows through R137; that is, none is left in the diode clamp circuit. Any further increase in i-f signal level will now cause the avc diode clamp to become negative with respect to the limiter cathode (terminal 7), applying negative bias to the avc bias line.

Squelch Circuit. A squelch circuit for controlling the noise output of the receiver under no-signal conditions is incorporated in the R-32. The circuit consists of diode CR101 and a voltage divider made up of resistors R158 and R161. Diode CR101 is connected between the signal line that feeds the grid of the second audio amplifier and the cathode of the second audio amplifier. The voltage divider allows the conduction point of CR101 to be adjusted by R161, which is the SQUELCH control on the front panel of the R-32. Under no-signal conditions CR101 conducts and clamps the signal line from the first audio amplifier to the cathode of the second audio amplifier, preventing any noise signals present from being amplified in the second audio amplifier. As a result, noise entering the receiver between channels is prevented from reaching the receiver output. However, when a signal is received, C160 and the voltage divider consisting of resistors R160 and R161 cause the polarity across diode CR101 to reverse. This reversal cuts off the diode and allows the signal to be amplified in the second audio amplifier.

4–5. B-13A CONVERTER.

The ARC Type B-13A Converter is designed to accept the VOR (omni) information delivered by the R-32 Receiver and convert and interpret it in such a way that the bearing of the receiving antenna from the transmitting antenna may be determined. It is also designed to accept the VAR and localizer information from the R-32 Receiver and convert it to a form that is presented visually through the vertical pointer of the IN-10. Insofar as the VOR circuit of the B-13A Converter is concerned, the navigational signal from the R-32 Receiver consists of two independent components. One is 30 cps and is known as the "variable channel" signal. Its phase in space at any given instant is a function of the bearing from the transmitter. The other is 10 kc (actually 9960 cycles) and is known as the "reference channel" signal. This signal is frequency-modulated at a 30-cps rate to 480 cps above and below 9960 cycles. After this signal passes through a filter, limiter, and discriminator, the 30-cps voltage is known as the "reference channel signal." The phase of the reference channel is independent of the bearing from the transmitter. Omnidirectional range transmission is such that for a signal received north (magnetic) of the VOR station, the 30-cps variable-channel amplitude modulation is in phase with the 30-cps frequency modulation of the 10-kc channel. When this signal is being received, the data presented by the IN-10 Course Indicator will be 0° TO or 180° FROM the station. (All bearings are *magnetic* in VOR.) At all points around the transmitter, the two 30-cps voltages differ in phase by an amount equal to the receiving antenna's bearing *from* the transmitter. The function of the VOR section of the B-13A Converter, with the aid of the IN-10 Course Indicator, is to measure this phase difference, which is then read on the IN-10 as a bearing TO or FROM the VOR station. A block diagram of the B-13A Converter is shown in Figure 4–4 and its schematic diagram in Figure 6–3.

The 10-kc FM signal is diverted by filters into the reference channel consisting of V201A, V203A, V203B, V204A, V205A, V204B, and T201. The 30-cps AM signal is diverted by filters into the variable channel consisting of V205B, V201B, and T202. The secondary circuits of T201 and T202, with the IN-10, determine whether the two secondary voltages are 90° apart in phase and which phase is leading. The course selector portion of the IN-10 and its associated circuits can be used to shift the phase of the reference channel signal as desired until the vertical pointer indicates that the two phases are 90° apart. When this condition exists, the vertical pointer is centered.

Reference Channel Circuit. The 10-kc FM signal from the cathode of the first audio amplifier in the R-32 Receiver is passed by the 10-kc high-pass filter consisting of C201 and R201. This filter rejects the 30-cps variable channel signal. V201A amplifies the 10-kc signal to a level of approximately 13 volts. The cathode resistor

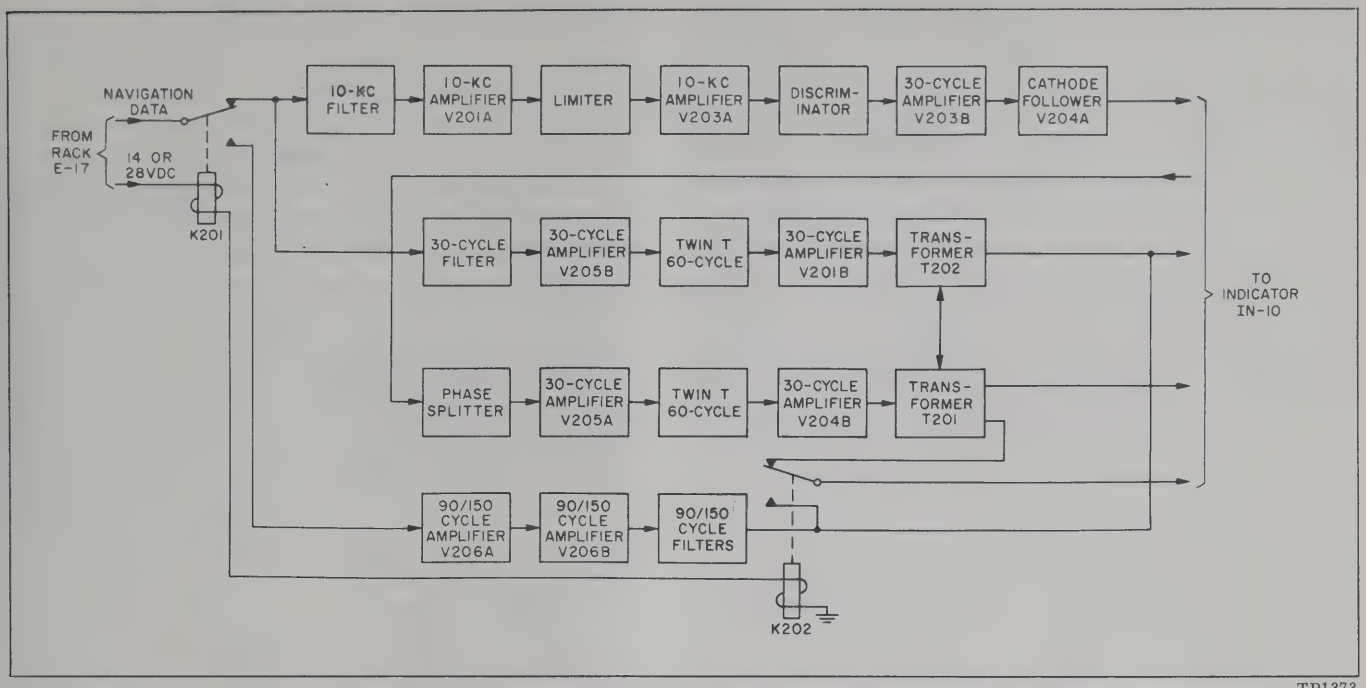


Figure 4–4. ARC Type B-13A Converter, Block Diagram

(R202) of this tube is not bypassed, and the tube operates in a degenerative fashion, which substantially reduces the effect of transconductance and heater and plate voltage variations. The output of the 10-kc amplifier is fed to the limiter. The purpose of the limiter is to remove any AM that might be present on the 10-kc signal. It consists of CR201, CR202, R204, R205, R206, R207, and V202. The limiter clips both the top and bottom of the 10-kc wave until the amplitude is only approximately one-third of its original value. C202 and C203 isolate the limiter from the d-c plate voltage of V201A and prevent the direct current from the limiter from affecting the d-c grid voltage of V203A. The clipped 10-kc amplifier, V203A, amplifies the clipped 10-kc signal from the limiter. Its output is then fed to the discriminator, which consists of Z201, CR203 and CR204, C204 and C205, and R211 and R212. The discriminator extracts the 30-cps modulation from the 10-kc FM signal and feeds this modulation to the 30-cycle amplifier where it is amplified and sent through a cathode follower to the course selector portion of the IN-10. The cathode follower, V204A, matches the high output impedance of the 30-cycle amplifier to the low impedance of the course selector. The rotor circuit of the course selector is an unbypassed cathode impedance.

The two stator windings of the course selector, which are spaced 90° apart, feed the RC circuit consisting of R221, R222, and C210. Since the voltage of each stator varies according to the sine law as the rotor is revolved, and the two stators are placed 90° apart, the course selector, in combination with the RC circuit, constitutes a phase shifter. R222 is a selected-value resistor, chosen and installed at the time of final factory adjustment of the B-13A converter. Its value is chosen so as to minimize the course error deviation. R223 provides a grid return for V205A in case the course selector is not connected to the B-13A. R225 is variable, and with C211 acts as an adjustable phase-shifter over a limited range. The voltage at the output of the phase-shifter is amplified by the 30-cycle amplifier, V205A. The gain of this amplifier can be adjusted with variable resistor R226 in its cathode circuit. The reference channel signal is then filtered by a 60-cycle twin-T filter. This filter is used so that the frequency response of the reference channel is the same as that of the variable channel, which also contains a similar filter. Also, the filter removes any propeller modulation that may be present on the reference channel signal, even though the amount of propeller modulation on this FM signal is slight. The output of the filter is amplified by another 30-cycle amplifier, V204B, and fed to the primary of transformer T201. The primary of T201 is tuned to 30 cycles by C220.

Variable Channel Circuit. The low-pass filter consisting of C221, C222, and R242 passes the 30-cycle AM signal from the R-32 Receiver and suppresses the voice and 10-kc signals. The output of the filter is amplified by 30-cycle amplifier V205B and passed through a 60-cycle twin-T filter. The filter suppresses 60 cycles and eliminates any propeller modulation that may have been introduced. The 30-cycle signal passed by the filter is then amplified by another 30-cycle amplifier, V201B, and fed to the primary of transformer T202, which is tuned to 30 cycles by C233.

Vertical Pointer Circuit. The circuit in the B-13A converter that operates the vertical pointer of the IN-10 Course Indicator is essentially a wattmeter. No current flows through the vertical pointer meter coil when the outputs of T201 and T202 are 90° apart in phase. If the outputs are not quite 90° apart, the vertical pointer will swing to the left or right, indicating that the signal being received is not quite on course; an on-course signal produces transformer outputs that are 90° apart in phase. The wattmeter circuit consists of CR207, CR208, R238, R239, and R240, and the vertical pointer movement of the indicator. The purpose of R238 and R240, in series with CR207 and CR208, respectively, is to build out the forward resistance of these two crystals to a point where normal changes in the forward current resistance of the crystals are relatively unimportant. The purpose of the adjustable resistance, R239, is to permit the selection of an exact mid-tap point between the crystals. It is necessary that this point be used; otherwise, the voltage from T201 alone would cause a deflection of the IN-10 vertical pointer. In a wattmeter circuit the presence of a voltage in one phase alone cannot cause current to flow in the meter.

Flag Circuit. The flag is operated by the same pair of crystals used in the indicator circuit. In this circuit, however, the flag current results from the sum of the outputs from T201 and T202, and hence the loss of output from either T201 or T202 results in a substantial reduction of flag current.

To-From Circuit. The TO-FROM meter circuit is similar to the wattmeter used in the vertical pointer circuit. The voltage from T202 feeding this wattmeter circuit, however, is shifted approximately 90° by R253 and C235. This circuit uses crystals CR205 and CR206, and resistors R235 and R236. Since this circuit operates at approximately 90° from the other, it resolves the ambiguity of two positions on the course selector at which the vertical pointer reads zero.

VAR and Localizer Circuit. The VAR or localizer circuit of the B-13A Converter is a two-stage resistance-coupled amplifier designed to accept the VAR and localizer information delivered by the R-32 Receiver and convert it for visual presentation through the vertical pointer of the IN-10. When the OMNI-VAR LOC switch on the control unit is set to the VAR LOC position, K201 and K202 are energized. K201 connects the navigational audio output of the R-32 (terminal 2, J204) to the grid of V206A. The two triode sections of V206 constitute a conventional two-stage amplifier whose output is fed to a 90-cps and a 150-cps filter in parallel. The cathodes of V206 are not bypassed, and therefore cause degeneration, which makes the amplifier relatively independent of variations in heater and plate voltages. R257, factory-set and locked, adjusts the amplifier gain, which in turn determines the course-width sensitivity. The gain at 90 cps is substantially the same as at 150 cps. The 90-cps component of the input signal is selected by the 90-cps filter, Z202, which feeds CR209. The 150-cps component is selected by Z203, which feeds CR210. In order to make the output voltages of the two filters equal, variable resistor R264 is used to control the relative output of these filters. The outputs of Z202 and Z203 are used in a balanced circuit so that when they are equal no voltage is produced across the vertical pointer meter movement, which is connected across R262 and R265. The 90-cps output produces a voltage drop across R262, which is equal and opposite to the voltage drop across R265 caused by the output of the 150-cps filter. Each filter output produces a voltage drop, in the same sense, across R263, the sum of which causes a flag current. This current will be substantially reduced by a loss in either output. The flag alarm movement of the indicator is connected to terminals 4 and 5 of J205.

4–6. IN-10 COURSE INDICATOR.

The cross-pointer-meter section of the IN-10 is a special type of microammeter with two pointer mechanisms, and two flag alarm mechanisms for indicating the operating or non-operating condition of the pointer mechanism.

The vertical pointer visually indicates the VOR, VAR, or localizer information received from the B-13A Converter circuits. It is pivoted at the top and moves left and right to supply a visual indication of the lateral position of the aircraft with respect to the on-course signal of the VOR, VAR, or localizer. The horizontal pointer is pivoted at the left and moves up and down; however, it is not used for Type 15E operation. A red flag alarm warning is associated with each pointer to indicate the relative operating strength of a received signal. The vertical pointer flag alarm and the TO-FROM meter indication serve to indicate the presence or absence of proper output signals from the B-13A Converter.

The course selector portion of the IN-10 permits the selection of any desired track to or from a VOR station, or indicates the magnetic bearing of the aircraft from a VOR station. The TO-FROM meter is a zero-center d-c instrument that provides the sense information required to resolve any ambiguity in the reading of the course indicator dial. The meter will show TO when the indicated bearing on the course indicator dial is the magnetic bearing *to* the station. It will show FROM when the indicated bearing on the course indicator dial is the magnetic bearing *from* the station. When reading the to-from meter, the vertical pointer should be approximately centered. When neither TO nor FROM is indicated, it may be that the indication is passing through the neutral point on the way from one indication to the other, or the received signal may be too weak to be reliable, or the received signal may not be a proper signal.

4–7. C-1254A CONTROL UNIT.

The ARC Type C-1254A Control Unit provides for remote power control of the Type 15E, remote tuning and volume control of the R-32 Receiver, selection of either VOR or VAR and localizer operation, and whistle-through tuning. It is illuminated by three lamps that receive their power directly from the aircraft's electrical system through a rheostat that controls the intensity of illumination. A schematic diagram of the C-1254A Control Unit is shown in Figure 6–11.

Power to the Type 15E is controlled by the OFF switch, S1501, on the C-1254A Panel. This switch is combined with the VOL control for the audio output of the R-32. Remote tuning of the R-32 is accomplished by means of the tuning crank on the C-1254A and the mechanical linkage between the C-1254A and the R-32 Receiver. VOR or VAR and localizer operation is selected by the OMNI-VAR LOC switch, S1502, which energizes relays K201 and K202 in the B-13A Converter. When the tuning crank on the C-1254A is depressed, switch S1503 closes and energizes the whistle-through tuning circuits in the associated ARC transmitter.

4–8. C-22A AND C-1254 CONTROL UNITS.

The ARC Type C-22A and C-1254 Control Units function the same as the C-1254A Control Unit, with minor exceptions. Neither the C-22A nor the C-1254 have provisions for whistle-through tuning. Also, the C-22A has no front panel lamps.

SECTION V
MAINTENANCE

5–1. INTRODUCTION.

This section provides performance check-out procedures, trouble-shooting information, maintenance data, and alignment and adjustment procedures for the R-32 Receiver and B-13A Converter. Performance of the other operating units of the Type 15E can best be checked by substituting them individually in a "standard" Type 15E system, and performing a general operative test similar to that described under paragraph 2–8. If the IN-10 Course Indicator requires adjustment or repair, it should be returned to the factory or to a qualified overhaul station for such maintenance. To supplement the information given, reference should be made to the applicable schematic, wiring, and voltage and resistance diagrams included in Section VI.

5–2. TEST EQUIPMENT.

The maintenance procedures for the Type 15E require the following test equipment:

1. Audio Oscillator, Hewlett-Packard Model 200AB, or equivalent (for modulation frequencies other than 1000 cps)
2. Bench Test Kit ARC Type BTK-15
3. Crystal Calibrator, Ferris Model 33
4. Headset, high impedance
5. Milliammeter, 0-1 ma, 30 ohms d-c resistance (tuning meter)
6. Milliammeter, 0-25 ma, with standard telephone plug
7. Multimeter, Simpson Model 260 or Triplett Model 630, or equivalent
8. Output Meter, Weston Model 687 or Simpson Model 427, or equivalent
9. Signal Generator, ARC Type H-14A or ARC Type H-14 with 111-mc and 131-mc crystals
10. Signal Generator, Ferris Model 16C, or equivalent, for 15-mc i-f measurements, and Signal Generator, Boonton Radio Type 202-B for r-f measurements; or, Hewlett-Packard Model 608D for both i-f and r-f measurements.
11. Tube Tester, Weston Model 798, or equivalent
12. "Standard" ARC Type 15E Equipment for component substitution tests
13. Vacuum Tube Voltmeter, Ballantine Model 300, or equivalent.
14. Voltmeter, dc, 0-50 volts, for primary power measurements.

Instructions for the proper use of these test equipments are given; preliminary set-up or operating instructions are not included since such information is contained in the applicable instruction book. In addition to the test equipment listed, a suitable 14-volt or 28-volt dc primary power source, depending on the voltage rating of the Type 15E, is required. Preferably, this source should be continuously adjustable, although a series of 2-volt storage cells can be used. If quantitative measurements of cross-pointer, flag-alarm, and to-from meter movements are desired, the following may be used: for the vertical needle movement, a 150-0-150 microammeter of 1000 ohms resistance; for the flag movement, a 0-1 milliameter of 1000 ohms resistance; for the to-from meter movement, a 150-0-150 microammeter of 1000 ohms resistance.

5–3. GENERAL MAINTENANCE INFORMATION.

System Trouble Analysis. The units of the Type 15E are designed and factory-adjusted to be individually interchangeable; that is, any unit may be replaced by a similar unit without upsetting the overall calibration of the system. Therefore, during an operative check of a Type 15E installation, it is practical to localize a faulty component by substituting, one at a time, the components of a "standard" Type 15E. Once isolated, the faulty component may be subjected to standard maintenance procedures such as tube substitution, voltage and resistance measurements, and continuity checks in an attempt to localize and repair the fault. If these methods do not suffice, then a detailed trouble-shooting procedure, similar to that outlined in Tables 5–1 and 5–2, should be used.

Electron Tube Replacement. Only the R-32 Receiver and the B-13A Converter contain electron tubes (refer to Figures 5–1 and 5–2). All tubes are accessible with the removal of the top cover.

Caution

If tubes are removed for testing, replace those that test "good" in the same socket from which they were removed. If V104 of the R-32 is replaced, the r-f oscillator trimmer capacitor, C102H, must be readjusted. Refer to paragraph 5–7.

Panel Lamp Replacement. The C-1254 and C-1254A Control Units contain three GE Type 327 (28-volt) or three GE Type 330 (14-volt) midget, flange-base panel lamps installed in lamp sockets located on the front panel. To replace any one of these lamps, proceed as follows:

Step 1. Unscrew the lamp housing assembly, and remove together with the rubber light shade and lamp.

Step 2. With the thin edge of a knife blade (or the fingernails of the thumb and forefinger) inserted between the flange base of the lamp and threaded bushing, withdraw the defective lamp.

Step 3. Insert a new lamp, seating the flange of the base firmly against the threaded bushing.

Step 4. Replace the lamp housing assembly, and screw in finger-tight.

Crystal Diode Replacement. The B-13A Converter contains ten crystal diodes located on the top of the chassis under the protective cover at the rear. These crystals are soldered in position and no special procedures are required for their replacement. When soldering a diode, however, take care to avoid overheating the crystal. Use a "thief" (heat sink) between the crystal and the soldering point.

Reforming Electrolytic Capacitors. Whenever the E-16, E-17, and E-18 Racks are serviced, or in any case every two years, the 1000-uf electrolytic capacitors should be reformed at their rated voltage. To reform these capacitors, proceed as follows:

Step 1. Disconnect all interconnecting cables. Remove the R-32 and B-13A Converter from the rack(s).

Step 2. Remove the rear cover of the rack. In the E-16, unsolder one end only of R1701 and R1702. In the E-17 unsolder one end only of R401, R402, R403, and R404. In the E-18 no unsoldering is required.

Step 3. Connect a battery having the rated voltage, $\pm 10\%$, of the capacitor through a current limiting resistor of approximately 22 ohms. With the battery negative connected to the negative terminal of the capacitor (not ground), apply the battery voltage across each capacitor for a period of at least 10 minutes.

Step 4. After reforming the capacitors, discharge each capacitor by shorting it for a few minutes before resoldering the connections.

Caution

If the capacitors are not discharged, when the B-13A is reinstalled, the IN-10 Course Indicator may be damaged due to the capacitors discharging through it.

Step 5. Reconnect the resistors. Replace the back cover of the rack. Reconnect all cabling.

Effects of Radio Receiver Phase Shift. The phase of the 30-cycle navigation output from the R-32 leads the phase of the input modulation envelope by 192° when the navigation output line is open-circuited. (The phase difference is 189° when the navigation output is loaded by the input impedance of the B-13A.) This phase shift results from the detector-noise limiter circuits of the R-32, and is carefully adjusted during manufacture by proper choice of the value of R141 in relation to the detail parts of Z105, the fourth i-f coupling unit, and C153A,B. Since the precision of this factory adjustment is greater than that which can be achieved readily in the field, it is recommended that no field adjustments be made. The critical parts that determine this phase are Z105, C153B,C, and R141. If any of these parts are changed, the R-32 should be returned to the factory for precise readjustment. A defective detector-noise limiter tube, V109, may also cause a phase shift.

Improper phase shift may also result if the R-32 has defective parts other than the critical ones mentioned above, but these will produce abnormal effects that will be noted under normal testing, such as described in Table 5–1. In particular, the navigation output voltage must be within limits and the avc must be operating properly. Significant phase errors in the R-32 may be detected by the substitution of a "standard" receiver in the system and noting any change in course, or by noting the overall error in the system after the other components have been checked.

When the B-13A Converter is fed directly from the DEMOD output of the ARC Type H-14 or H-14A Signal Generator during course accuracy checks, on-course indications should be obtained when the reading on the IN-10 is 192° greater than the H-14 or H-14A OMNI TRACK angle; that is, at an omni track of 0°, an on-course indication should correspond to an IN-10 reading of 192° TO; at a 300° track angle, an on-course indication should be obtained at 132° (492 minus 360); and similarly for other courses. The reason for this difference is that the open-circuit phase of the H-14 or H-14A DEMOD output is 192° behind the corresponding R-32 output phase. Therefore, the course indicator must be rotated to advance the phase by 192° in the B-13A. The open-circuit phase of the H-14 or H-14A DEMOD output is the same as the phase of the modulation on the r-f output; moreover, the output impedance of the DEMOD output is the same as the output impedance of the R-32 navigation output circuit. Consequently, the phase shift (approximately 2° lag) caused by the loading of either the R-32 or the signal generator DEMOD output by the input impedance of the B-13A is the same and need not be considered during course accuracy measurements of the B-13A. For these reasons, a perfect B-13A should produce on-course indications on the cross-pointer meter of the IN-10 whenever the TO reading of the to-from meter is 192° greater than the setting of the H-14 or H-14A OMNI TRACK switch, or when the FROM reading of the of the to-from meter is 12° greater.

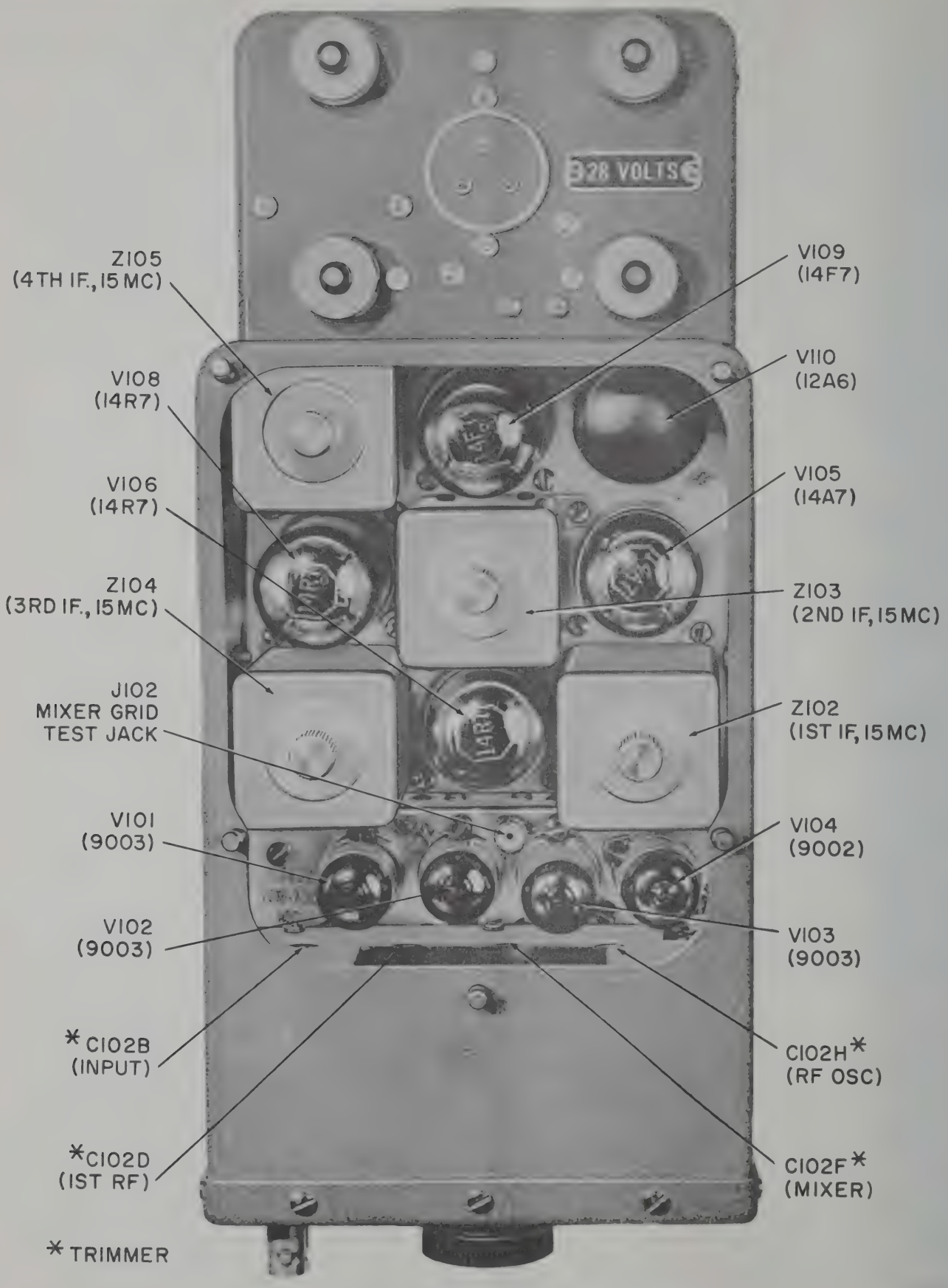


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Figure 5–1. ARC Type R-32 Receiver, Top Interior View

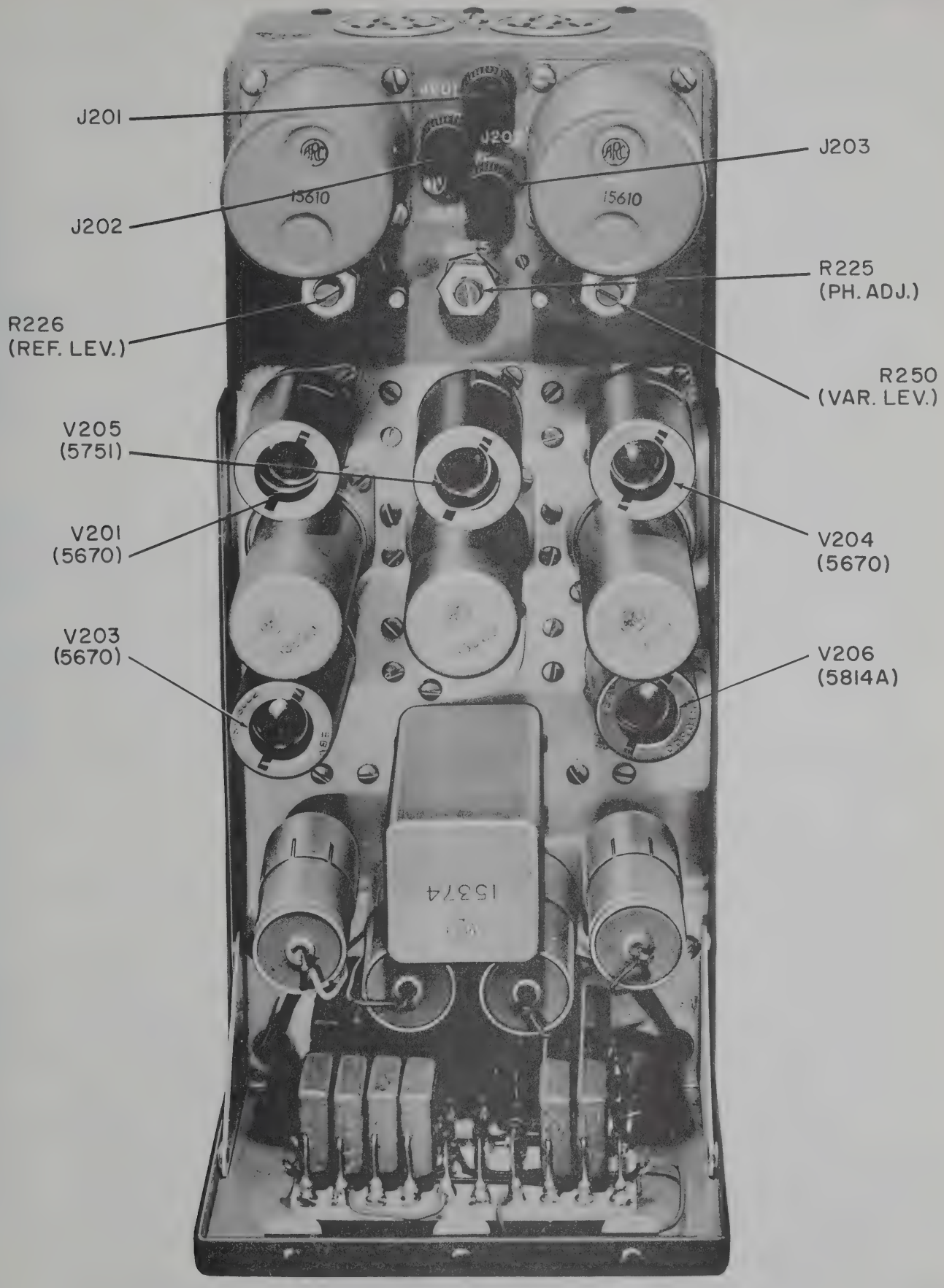


Figure 5–2. ARC Type B-13A Converter, Top Interior View

TP1226A

5–4. LUBRICATION.

Control Untis. The teeth of the spur gears and spline in the C-1254 and C-1254A Control Units, and of the spur gears, bevel gears, and spline in the C-22A Control Unit, should be lubricated with a very light application of grease, equivalent to Esso Beacon No. 325. Shaft bearings should be oiled with a light machine oil.

Mechanical Linkage. Except during assembly of the mechanical linkage, as described in Section II, no lubrication of any kind should be applied to the mechanical linkage.

5–5. PRELIMINARY MAINTENANCE CHECKS.

The following precautions should be observed and checks made before testing or aligning the Type 15E:

1. Check the primary power source. The Type 15E requires 2.9 amperes at 28 volts dc, or 5.8 amperes at 14 volts dc.

2. Check the mechanical linkage in use. It should be as short as possible, reasonably straight, and in good condition. Connect the mechanical linkage between receiver and control unit, and align the control unit frequency dial and receiver tuning capacitor as described in paragraph 2–7. In a bench test set-up, the linkage should be secured in a fixed position. If the linkage is permitted to move about, the angular relation between its end fittings may change and upset the mechanical alignment between the receiver tuning capacitor and the control unit dial.

3. Check the condition of all interconnecting cables and check all cable connections. For a bench test, interconnect the ARC Type BTK-15 Bench Test Kit and the Type 15E as shown in Figure 5–3.

4. To avoid shunting the 300-ohm audio load resistor in the receiver test harness of the ARC Type BTK-15 Bench Test Kit, keep the volume control knob of the control unit in its full clockwise (maximum) position, and leave the wiring to the aircraft audio distribution point open-circuited. Also, if a monitoring headset of less than 5000 ohms impedance is used in the TEL jack of the receiver test harness, disconnect the headset while making measurements of the audio output voltage at the TEL V test point on the receiver test harness.

5. Make certain that wired plug ARC-11934 is installed in J105 of the R-32 Receiver to complete the high-voltage circuit.

6. The B-13A Converter is designed and adjusted to operate three 1000-ohm vertical needle movements and three 1000-ohm flag alarm movements, or equivalent loads (refer to paragraph 5–2). This load condition must be maintained during testing.

5–6. R-32 RECEIVER PERFORMANCE TESTS AND TROUBLE ANALYSIS.

Table 5–1 outlines the procedures for checking and analyzing the performance of the R-32 Receiver. The type of test, or the circuit under test, is identified by a subtitle preceding the test. Secondary steps marked, for example, 3A, 3B, 5A, etc., need not be performed unless an abnormal indication is obtained in the basic steps and further testing is required to localize the trouble. The tests should be conducted in the order listed, as some of the steps presuppose previous satisfactory results. The possible causes of abnormal indications are localized to specific circuits or parts. This information should be supplemented by referring to the circuit discussion in Section IV and to the applicable diagrams in Section VI. Voltage values noted are approximate, with a tolerance of ± 10 per cent.

Unless the R-32 under test requires alignment, any or all of the tests in Table 5–1 may be made without prior alignment. Alignment procedures are given in paragraph 5–7.

5–7. ALIGNMENT OF R-32 RECEIVER.

Sense and Preferred Setting of Trimmer Capacitors. When the R-32 is aligned at the factory, the trimmers are left in such a position that further clockwise rotation will increase capacity. The maximum capacitance position is obtained when the top of the cross on the rotor slot is aligned with the fixed fiducial line. Turning the rotor 180° in either direction reduces the capacitance to a minimum. When trimming a circuit, always tune in a counterclockwise motion from the maximum capacitance setting. This method of tuning will result in a setting of the trimmer such that a clockwise motion increases capacitance.

Alignment of I-f Circuits. To align the i-f circuits of the R-32, proceed as follows:

Step 1. Interconnect the test equipment, except the H-14 or H-14A signal generator, and the R-32 under test as shown in Figure 5–3.

Step 2. Turn the equipment on and adjust the RF SENS control of the receiver test harness for maximum gain. Allow a 15-minute warm-up period to insure stabilization. The sensitivity control is to remain in the maximum position throughout this procedure. The volume control (OFF) on the control unit should be kept at its maximum clockwise position.

Step 3. Connect the Ferris Model 16C Signal Generator, or the Hewlett-Packard Model 608D, to the grid of mixer V103 with Test Probe ARC-16139 or a short length of 0.050-inch diameter insulated wire inserted into i-f test point J102. If the test probe is not used, connect the signal generator ground lead as close as possible to the ground of J102.

Step 4. Tune the signal generator to 15 mc, modulated 30 per cent at 400 cycles by the Hewlett-Packard

Model 200AB audio oscillator. Tune the R-32 to 131 mc as accurately as possible, as indicated by the control unit frequency dial.

Step 5. Remove the knurled cap from each i-f coupling unit.

Note

There are two holes under the knurled caps, marked "1" and "2." The trimmer at "1" tunes the primary circuit and the trimmer at "2" tunes the secondary circuit.

Step 6. Beginning with Z105, the fourth i-f coupling unit (refer to Figure 5–1), make a preliminary alignment of the eight i-f trimming capacitors, alternating from "2" to "1" of each unit. Adjust each trimmer for maximum output. Throughout this procedure keep the receiver output below 2 volts across the 300-ohm load by adjusting the output of the signal generator.

Step 7. For final i-f alignment, detune the primary of Z105 in whichever direction gives maximum detuning; then adjust the secondary of Z105 for maximum output. Without any readjustment of the secondary, readjust the primary for maximum output. Keep the receiver output below 2 volts.

Step 8. Repeat the procedure of Step 7 for Z104, Z103, and Z102, in sequence.

Step 9. Replace all knurled caps on the i-f coupling units.

Alignment of R-f Circuits. To align the r-f circuits of the R-32 proceed as follows:

Step 1. Interconnect the test equipment, including Signal Generator H-14 or H-14A, and the R-32 under test, as shown in Figure 5–3.

Step 2. Turn the equipment on, adjust the receiver test harness RF SENS control for maximum gain, and allow a 15-minute warm-up period to insure stabilization. The volume (OFF) control on the control unit must remain in the maximum clockwise position throughout this procedure.

Step 3. Connect the H-14 or H-14A ATTEN output to the antenna connector J101 on the front panel of the R-32.

Step 4. Adjust the H-14 or H-14A to 131 mc, modulated 30 per cent at 400 cycles by the Hewlett-Packard Model 200AB audio oscillator. Tune the R-32 to the signal generator output frequency as accurately as possible. Check that the control unit frequency dial has been set in accordance with the directions outlined in paragraph 2–7, and set the dial exactly at 131 mc.

Step 5. With the signal generator output set at 1000 microvolts, and using the special capacitor alignment tool, Wrench ARC-10307, adjust the four gang-trimmer capacitors (see Figure 5–1) starting with the r-f oscillator trimmer C102H. In sequence, adjust second r-f amplifier trimmer C102F, first r-f amplifier trimmer C102D, and antenna trimmer C102B for maximum output. Throughout this trimming procedure keep the receiver output below 2 volts by appropriate adjustment of the signal generator output.

Note

Of the four trimmers, r-f oscillator trimmer C102H is the most critical in adjustment. Also, it requires retrimming each time the r-f oscillator tube, V104, is replaced.

TABLE 5–1. R-32 RECEIVER PERFORMANCE AND TROUBLE ANALYSIS CHECK CHART

Step	Procedure	Normal Indications	Possible Cause of Abnormal Indications
	LOW- AND HIGH-VOLTAGE TESTS		
1	Interconnect the "standard" Type 15E, substituting the R-32 under test for the "standard" R-32, and the required test equipment as shown in Figure 5–3 (unconnected test equipment shown in the figure is to be connected as and when directed in this procedure.)	None.	None.
2	Adjust the primary voltage to 28 volts. Connect d-c voltmeter (30-volt range) to LV+ and G of receiver test harness. Turn on primary power source. Turn control unit OFF control clockwise (on). Allow equipment to warm up for at least 15 minutes.	Meter reads 28 volts. Dynamotor operates. Electron tube filaments light.	Connector J102 (terminals 6 and 1). Coil L110. Capacitor C131C. Connector J104 (terminals 2 and 1). Defective electron tubes.

TABLE 5–1. R-32 RECEIVER PERFORMANCE AND TROUBLE ANALYSIS CHECK CHART—Continued

Step	Procedure	Normal Indications	Possible Cause of Abnormal Indications
	LOW- AND HIGH-VOLTAGE TESTS—Continued		
3	Connect d-c voltmeter (500-volt range) to HV+ and G of receiver test harness.	Meter reads 253 volts.	Wired plug ARC-11934 at J105 missing or defective. Connector J103 (terminals 7 and 1). High voltage circuit details; proceed with Steps 3A, 3B, and 3C.
3A	Disconnect wired plug ARC-11934 from J105. Connect d-c voltmeter (500-volt range) between terminals A and C of J105.	Meter reads 277 volts; if normal, proceed to Step 3B.	Capacitor C131B or C135. Connector J104 (terminals 3 and 1). Connector J105 (terminals A and C).
3B	Reconnect wired plug ARC-11934 to J105. Connect d-c voltmeter (500-volt range) between terminals E and C of J105.	Meter reads 353 volts.	Proceed to Step 3C; if reading of Step 3C is normal, L112 defective; otherwise, check possible causes of Step 3C.
3C	Connect d-c voltmeter (500-volt range) between terminal 2 of L112 and chassis ground.	Meter reads 277 volts.	Connector J105 (terminal E). Decoupling capacitors such as C140, C142, C153A, C130A, etc. in high-voltage circuit.
	CALIBRATION CHECK		
4	Adjust the control unit frequency dial in relation to the R-32 tuning capacitor (refer to paragraph 2–7). Install 111-mc and 131-mc crystals in the H-14 or H-14A Signal Generator. Connect the signal generator ATTEN output to J101. Turn receiver test harness RF SENS control to MAX position. Operate the signal generator as outlined in applicable instructions, adjusting the OUTPUT ATTENUATOR for a low-level input signal to the R-32. Tune the R-32 to the 131-mc signal from the signal generator, tuning for maximum audio output.	Control unit dial is no more than one line-width (approximately 1/32 inch) in error. Audio output is audible and undistorted.	Defective electron tubes. Local oscillator misaligned; realign C102H (refer to paragraph 5–7).
	Tune the R-32 to the 111-mc signal from the signal generator, tuning for maximum audio output.	Control unit dial-reading error is no more than two line-widths.	R-32 misaligned (refer to paragraph 5–7).
	R-F SENSITIVITY		
5	Connect the DEMOD output of the H-14 or H-14A Signal Generator to the EXT NAV MOD connector of the receiver test harness. Connect the Hewlett-Packard Model 200AB audio oscillator to the EXT MOD binding posts of the signal generator. Tune the R-32 to the 131-mc signal modulated 30% at 400 cps, derived from the signal generator and audio oscillator. With the Ballantine Model 300 vtvm connected	Required r-f input to R-32 is less than 5 microvolts as observed on signal generator OUTPUT ATTENUATOR. (If normal, proceed with Step 6, if desired, or with Step 7.)	If required r-f input is substantially more than 5 microvolts, localize trouble to either the r-f section by proceeding with Steps 5A through 5H, as required, or to the i-f and audio section by proceeding with Steps 6, and 6A through 6M, as required.

TABLE 5–1. R-32 RECEIVER PERFORMANCE AND TROUBLE ANALYSIS CHECK CHART—Continued

Step	Procedure	Normal Indications	Possible Cause of Abnormal Indications
	R-F SENSITIVITY—Continued		
5 (cont.)	to the TEL and G test points of the receiver test harness, adjust the r-f output of the signal generator to obtain a reading of 1.73 audio output volts on the vtvm with the R-32 tuned accurately for maximum output.		
5A	Increase the r-f input to 10,000 microvolts, and rotate the receiver test harness RF SENS control to MIN.	The audio output can be cut off substantially. If normal, proceed with Step 6.	(Proceed with Steps 5B through 5H as required.)
5B	Connect d-c voltmeter (250-volt range) between pin 5 of V104 and chassis ground.	Meter reads 215 volts.	Resistor R113. Capacitor C117.
5C	Connect d-c voltmeter (500-volt range) between pin 5 of V102 and chassis ground.	Meter reads 220 volts.	Resistor R111. Capacitor C112.
5D	Connect d-c voltmeter (500-volt range) between pin 6 of V102 and chassis ground.	Meter reads 88 volts.	Resistor R108.
5E	Connect d-c voltmeter (10-volt range) between test point and chassis ground.	Meter reads 5.5 volts.	Resistor R104. Capacitor C109.
5F	Connect d-c voltmeter (500-volt range) between pin 5 of V101 and chassis ground.	Meter reads 214 volts.	Resistor R106. Capacitor C108. Coil L103.
5G	Connect d-c voltmeter (250-volt range) between pin 6 of V101 and chassis ground.	Meter reads 86 volts.	Resistor R105.
5H	Connect d-c voltmeter (10-volt range) between pin 7 of V101 and chassis ground.	Meter reads 5.2 volts.	Resistor R102. Capacitor C105.
	I-F SENSITIVITY AT MIXER (V103) GRID		
6	Connect Ferris Model 16C Signal Generator through Test Probe ARC-16139 (part of BTK-15) to J102. Tune signal generator to 15 mc modulated 30% at 400 cps supplied by Model 200AB audio oscillator. Adjust the input to the R-32 to a level low enough to prevent activating the avc circuit. Connect Ballantine Model 300 vtvm to the TEL V. test point of the receiver test harness. Adjust the output of the signal generator to obtain a reading of 1.73 volts on the vtvm.	The required number of microvolts should be between 120 and 400 for the 1.73-volt reading on the vtvm.	Tubes V103, V105, V106, V108. Detail parts of i-f circuits; make tests outlined in Steps 6A through 6H. I-f circuits misaligned (refer to paragraph 5–7).
6A	Connect d-c voltmeter (500-volt range) between pin 2 of V108 and chassis ground.	Meter reads 240 volts.	I-f coupling unit Z105. Resistor R134.
6B	Connect d-c voltmeter (10-volt range) between pin 7 of V108 and chassis ground.	Meter reads 5.5 volts.	Resistor R135. Capacitor C144C.
6C	Connect d-c voltmeter (500-volt range) between pin 5 of V108 and chassis ground.	Meter reads 252 volts.	Resistor R139. Capacitor C147.

TABLE 5–1. R-32 RECEIVER PERFORMANCE AND TROUBLE ANALYSIS CHECK CHART—Continued

Step	Procedure	Normal Indications	Possible Cause of Abnormal Indications
	I-F SENSITIVITY AT MIXER (V103) GRID—Continued		
6D	Connect d-c voltmeter (500-volt range) between pin 2 of V106 and chassis ground.	Meter reads 143 volts.	I-f coupling unit Z104.
6E	Connect d-c voltmeter (250-volt range) between pin 5 of V106 and chassis ground.	Meter reads 99 volts.	Resistors R127, R132, R133. Capacitors C131A, C137B.
6F	Connect d-c voltmeter (10-volt range) between pin 7 of V106 and chassis ground.	Meter reads 3.5 volts.	Resistor R125. Capacitor C136.
6G	Connect d-c voltmeter (500-volt range) between pin 2 of V105 and chassis ground.	Meter reads 237 volts.	I-f coupling unit Z103.
6H	Connect d-c voltmeter (250-volt range) between pin 3 of V105 and chassis ground.	Meter reads 98 volts.	Resistor R125. Capacitor C126.
6J	Connect d-c voltmeter (50-volt range) between pin 7 of V105 and chassis ground.	Meter reads 9.3 volts.	Resistor R118. Capacitor C125.
6K	Connect d-c voltmeter (500-volt range) between pin 5 of V103 and chassis ground.	Meter reads 236 volts.	I-f coupling unit Z102.
6L	Connect d-c voltmeter (250-volt range) between pin 6 of V103 and chassis ground.	Meter reads 175 volts.	Resistor R110. Capacitor C114.
6M	Connect d-c voltmeter (50-volt range) between pin 2 of V103 and chassis ground.	Meter reads 18 volts.	Resistor R109. Capacitor C113. Coil L105.
	AVC OPERATION CHECK		
7	Connect FM Signal Generator Type 202-B to J101, modulated 30% at 400 cps using Model 200AB audio oscillator and tuned to any frequency within the band (108-135 mc) of the R-32. Connect the vtvm to the TEL V. and G test points of the receiver test harness. Tune the R-32 for maximum audio output and measure the audio output volts with the vtvm for the input levels noted below. (The ratio of the output at 10,000 microvolts r-f input to the output at 100 microvolts r-f input is normally about 1.25. The input corresponding to the avc knee is defined as that input which causes the cathode current to decrease by 1 ma from its no-signal value. This input is normally about 8 microvolts.)		
	a. Input level at avc knee.	Meter reads 5 to 8.5 volts audio output.	Tubes V106, V107, V108. Other detail parts of avc circuit.
	b. Input level at 100 microvolts.	Meter reads 6.8 to 10 volts audio output.	
	c. Input level at 10,000 microvolts.	Meter reads 8 to 12 volts audio output.	

TABLE 5–1. R-32 RECEIVER PERFORMANCE AND TROUBLE ANALYSIS CHECK CHART—Continued

Step	Procedure	Normal Indications	Possible Cause of Abnormal Indications
	NAVIGATIONAL AUDIO FIDELITY		
8	Connect Ballantine Model 300 vtvm to the NAV MOD V. and G test points of the receiver test harness. Connect FM Signal Generator Type 202-B to J101, modulated 30% at an r-f level of 100 microvolts, and with the modulating frequencies derived from the Model 200AB audio oscillator, tabulated below:		
	a. Modulation frequency of 90 cps.	Meter reads 1.7 to 3.0 volts.	Tubes V109, V110. Transformer T101. Capacitor C163.
	b. Modulation frequency of 150 cps.	Meter reads 1.7 to 3.0 (±3%) volts.	Detail parts of audio amplifier and output circuits.
	c. Modulation frequency of 30 cps.	Meter reads 1.7 to 3.0 (±5%) volts.	
	d. Modulation frequency of 10,000 cps.	Meter reads 1.7 to 3.0 (+0, −20%) volts.	
	TUNING METER OPERATION		
9	Connect 0-1 ma milliammeter between terminals G and D of J404 in Rack E-17, or terminals G and D of J2002 in Rack E-18. Tune the R-32 through an r-f signal from FM Signal Generator 202-B (modulated or unmodulated).	At receiver resonance, meter reading should pass through a peak; note this point.	
9A	Connect the vtvm to either the NAV MOD V., or TEL V., and G test points of the receiver test harness. With a modulated r-f signal applied, tune the R-32 through resonance.	The vtvm should indicate a peak at the same tuning point.	
	OSCILLATOR STARTING SAFETY FACTOR		
10	Connect d-c voltmeter (30-volt range) to the LV+ and G test points of the receiver test harness. Connect Ballantine Model 300 vtvm to the TEL V. and G test points. Connect the headset to the TEL jack. Tune the R-32 to a signal from FM Signal Generator Type 202-B at about a 100,000-microvolt level. Gradually reduce the d-c primary power voltage to the R-32 until the abrupt disappearance of the signal indicates that the local oscillator has stopped functioning. Wait 10 seconds. Slowly increase the d-c primary power voltage until the oscillator starts again.	The point at which the oscillator starts to operate again is not greater than 20.0 volts for a 28-volt receiver and 10.0 volts for a 14-volt receiver, and should occur within 15 seconds.	Tube V104. Other detail parts of oscillator circuit.

5–8. B-13A CONVERTER PERFORMANCE TESTS AND TROUBLE ANALYSIS.

Table 5–2 outlines the procedures for checking and analyzing the performance of the B-13A Converter. The tests are subtitled to identify the circuit being checked. Secondary steps marked, for example, 6A,6B, etc., need not be performed unless an abnormal indication obtained in the basic step requires further testing to localize the trouble. Alignment procedures for the B-13A are given in paragraph 5–9.

TABLE 5–2. B-13A CONVERTER PERFORMANCE AND TROUBLE ANALYSIS CHECK CHART

Step	Procedure	Normal Indications	Possible Cause of Abnormal Indications
	PRELIMINARY PROCEDURE		
1	Interconnect the "standard" Type 15E substituting the B-13A under test for the "standard" B-13A, and the required test equipment as shown in Figure 5–3. (Unconnected test equipment shown in Figure 5–3 is to be connected as and when directed in this procedure.	None.	None.
2	Connect d-c voltmeter (30-volt range) to LV+ and G of converter test harness. Turn on primary power source. Turn control unit OFF control clockwise (on). Allow equipment to warm up for at least 15 minutes.	Meter reads 28 volts. Electron tube filaments light.	Connector J204. Defective electron tubes.
3	Connect d-c voltmeter (500-volt range) to HV+ and G test points of the converter test harness. Adjust the primary voltage input until the voltmeter reads 240 volts.	None.	None.
4	Connect Ballantine Model 300 vtvm between the NAV MOD V. and G test points of the receiver test harness. Set the receiver test harness NAV MOD SOURCE switch to EXTERNAL. Connect the DEMOD output of the H-14 or H-14A Signal Generator to the EXT NAV MOD connector of the receiver test harness. Set the control unit's OMNI-VAR LOC switch to OMNI. Operate and adjust the H-14 or H-14A with "level set" indications of the r-f level and the individual 30-cycle and 9960-cycle modulations as described in the applicable instruction book. Then set the signal generator's function selector switch to 30~ modulation, and adjust its DEMOD output to obtain a NAV MOD V. reading of 1.8 volts on the vtvm. Then set the signal generator's function selector switch to OMNI.	None.	None.
	OMNI TRACK ACCURACY CHECK		
5	Check the accuracy of the B-13A for each of the 24 OMNI TRACK ANGLE TO settings of the H-14 or H-14A Signal Generator; however, proper allowance must be made for the effect of omitting receiver phase shifts from the measurements. Refer to paragraph 5–3.	IN-10 vertical needle centers for each of the ANGLE TO tracks, flag alarm is out of sight, and to-from meter indicates TO.	Connectors J204, J205. Flag circuit detail parts: CR207, CR208, R237, R238, R239, R240. To-from meter circuit detail parts: CR205, CR206, R235, R236.
	Connect Ballantine Model 300 between K201 or R241 (yellow wire) and chassis ground.	Meter reads 2.3 volts.	Relay K201. Connector J204.

TABLE 5–2. B-13A CONVERTER PERFORMANCE AND TROUBLE ANALYSIS CHECK CHART—Continued

Step	Procedure	Normal Indications	Possible Cause of Abnormal Indications
	OMNI TRACK ACCURACY CHECK—Continued		
5 (cont.)	Connect d-c voltmeter (500-volt range) between line terminal of K201 (red wire) or positive terminal of C219B and chassis ground. Then connect meter between line terminal of K201 (red wire) and chassis ground.	Meter reads 240 volts in each case.	Connector J204, Capacitor C219B. Relay K201. Capacitors C219A, C209A, C209B, C207A, C207B, and other high-voltage circuit detail parts.
	VARIABLE CHANNEL TEST		
6	Connect Ballantine Model 300 between J202 and J203.	Meter reads between 3.6 and 4.0 volts.	Tubes V205B, V201B. Variable channel detail parts; proceed with Steps 6A through 6D, as required.
6A	Connect Ballantine Model 300 between pin 7 of V205 and chassis ground.	Meter reads 0.15 volt.	Detail parts of 30-cycle filter.
6B	Connect d-c voltmeter (500-volt range) between pin 6 of V205 and chassis ground.	Meter reads 150 volts.	Resistor R246.
	Connect Ballantine Model 300 between pin 6 of V205 and chassis ground.	Meter reads 8 volts.	
6C	Connect Ballantine Model 300 between pin 7 of V201B and chassis ground.	Meter reads 1.2 volts.	Detail parts of 60-cycle filter.
6D	Connect d-c voltmeter (500-volt range) between pin 6 of V201B and chassis ground.	Meter reads 220 volts.	Resistor R252. Capacitors C207B, C233. Transformer T202.
	Connect Ballantine Model 300 between pin 6 of V201B and chassis ground.	Meter reads 45 volts.	
7	Connect Ballantine Model 300 between J201 and J202.	Meter reads between 3.6 and 4.0 volts.	Tubes V201A, V203A, V203B, V204A, V205A, V204B. Reference channel detail parts; measure input and output a-c and d-c voltages and compare with values shown on Figure 6–17.
	VAR LOC CIRCUIT TESTS		
8	Same as Steps 1 through 4, except set control unit OMNI-VAR LOC switch to VAR LOC.	Same as Steps 1 through 4.	Same as Steps 1 through 4.
9	Set the H-14 or H-14A function switch to AMP LOC ⓘ (needle center).	The IN-10 vertical pointer centers. Vertical pointer flag alarm out of sight. (If a 0-1 ma 1000-ohm meter is used to replace the flag movement, its reading should be between 0.3 and 0.45 ma for a "needle center" position.	Balance resistor R264 misadjusted; readjust to obtain on-course reading.
10	Set the H-14 or H-14A function switch to AMP LOC ⓛ (needle left).	The IN-10 vertical pointer swings left to the outer edge of the blue sector. Vertical pointer flag alarm is out of	Sensitivity resistor R257 misadjusted; readjust to obtain proper "needle left" indication.

TABLE 5–2. B-13A CONVERTER PERFORMANCE AND TROUBLE ANALYSIS CHECK CHART—Continued

Step	Procedure	Normal Indications	Possible Cause of Abnormal Indications
		VAR LOC CIRCUIT TESTS—Continued	
10 (cont.)		sight. (This condition corresponds to 90 microamperes in the meter movement. A 1000-ohm 150-0-150 microammeter may be substituted for the IN-10 cross-pointer meter section, if desired.)	
11	Set the H-14 or H-14A function switch to AMP LOC ⊘ (needle right).	The IN-10 vertical pointer swings right to the outer edge of the yellow sector within about one needle-width (meter current should be 90, ±5, microamperes.) Vertical pointer flag alarm is out of sight.	If more than one needle-width in error, readjust sensitivity resistor R257 to split error in half between left and right sectors. If not possible to adjust R257 or R264 properly, detail parts of VAR LOC circuit may be faulty; measure input and output a-c and d-c voltages and compare with values shown on Figure 6–17.

5–9. ALIGNMENT OF B-13A CONVERTER.

Preliminary Procedure. Before proceeding to align the B-13A Converter, make the following tests and adjustments:

Step 1. Interconnect the test equipment and the B-13A under test as shown in Figure 5–3.

Step 2. Turn the equipment on and allow a 15-minute warm-up period to insure stabilization.

Step 3. With a d-c voltmeter (0-30 volt range) connected between the receiver test harness LV+ and G test points, adjust the primary source voltage to produce a reading of 27.5 volts for a 28-volt B-13A or 13.75 volts for a 14-volt B-13A.

Step 4. With the Ballantine Model 300 connected between the converter test harness NAV MOD V. and G test points, and with the NAV MOD SOURCE switch set at EXTERNAL, adjust the H-14 or H-14A Signal Generator for "level set" indications of the r-f level and the individual 30-cycle and 9960-cycle modulations as outlined in the H-14 or H-14A instruction book. Then with the H-14 FUNCTION switch set at 30~ MOD, or the H-14A MODULATION switch set at 30~, adjust the signal generator DEMOD output to obtain a NAV MOD V. reading of 1.8 volts. Set the FUNCTION or MODULATION switch to OMNI.

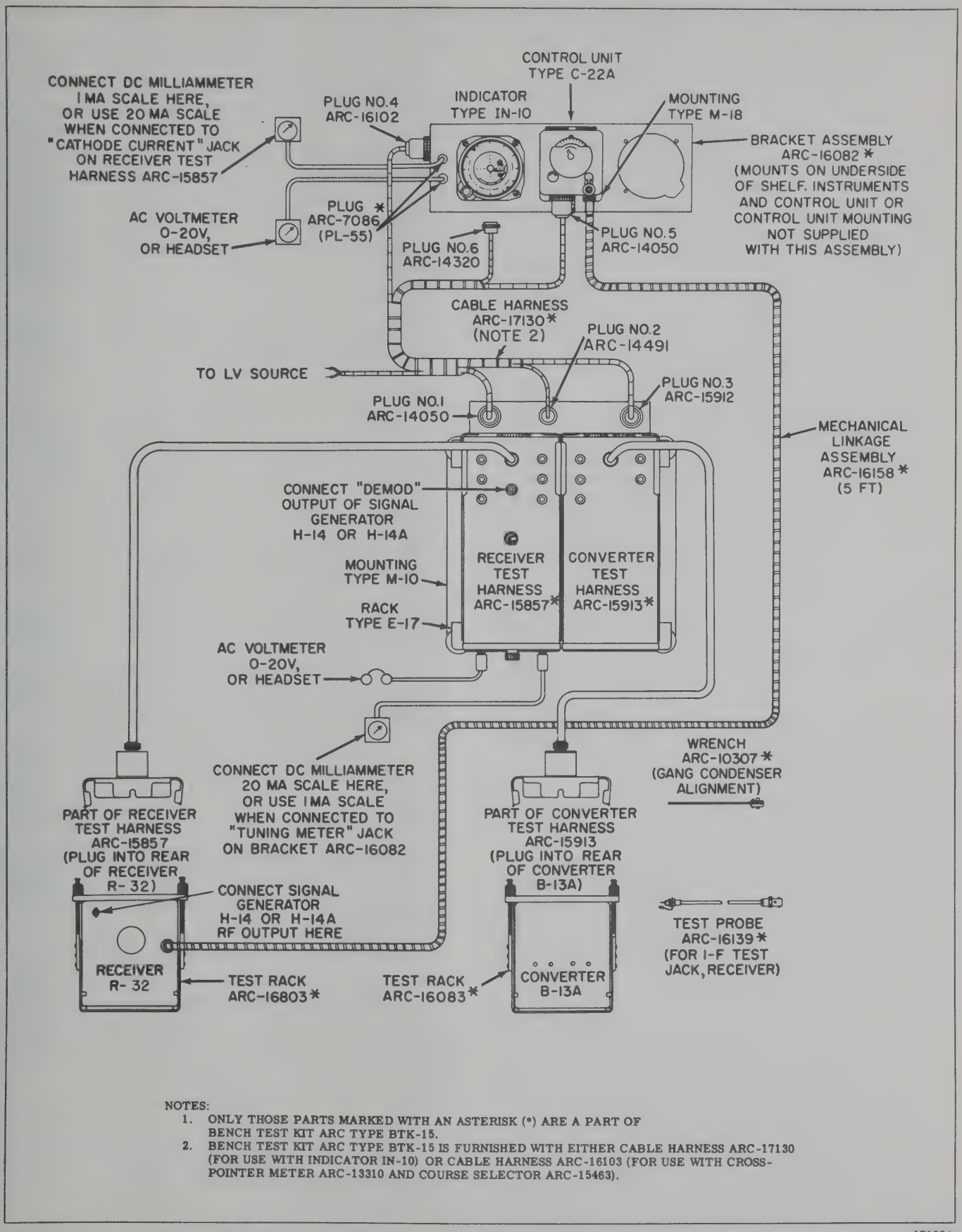
Step 5. Turn R226 to its extreme counterclockwise position, and set R225 and R239 approximately at mid position. R239 is located on the front panel of the B-13A.

Note

It is assumed that prior to alignment all electron tubes have been tested. Defective tubes should be replaced and non-defective tubes returned to their original sockets. If satisfactory alignment of the B-13A converter cannot be achieved, refer to Table 5–2.

Adjustment of VOR Section. Before adjusting the VOR section of the B-13A Converter, perform the preliminary procedures outlined previously in this paragraph; then perform the adjustments described in the following paragraphs.

ADJUSTMENTS OF VARIABLE CHANNEL. Connect the Ballantine Model 300 vtvm between B-13A test jacks J202 and J203. With the H-14 FUNCTION switch set to 30~ MOD, or H-14A MODULATION switch set to 30~, adjust the variable channel output voltage by means of VAR LEVEL control R250 to 4.0(±0.5) volts.



NOTES:
1. ONLY THOSE PARTS MARKED WITH AN ASTERISK (*) ARE A PART OF BENCH TEST KIT ARC TYPE BTK-15.
2. BENCH TEST KIT ARC TYPE BTK-15 IS FURNISHED WITH EITHER CABLE HARNESS ARC-17130 (FOR USE WITH INDICATOR IN-10) OR CABLE HARNESS ARC-16103 (FOR USE WITH CROSS-POINTER METER ARC-13310 AND COURSE SELECTOR ARC-15463).

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Figure 5–3. ARC Type 15E Equipment, Bench Test Interconnection Diagram Using Bench Test Kit ARC Type BTK-15

ADJUSTMENT OF REFERENCE CHANNEL AND PHASE COMPARISON CIRCUIT. To adjust the reference channel and phase comparison circuit, proceed as follows:

Step 1. With Signal Generator H-14 or H-14A set to 30~ modulation, make a preliminary adjustment of BAL potentiometer R239 to obtain an on-course indication on the IN-10 which is equivalent to zero current.

Step 2. Set the signal generator modulation switch to OMNI, the OMNI TRACK switch to 0°, and the IN-10 course indicator to 191.5°.

Step 3. Connect the Ballantine Model 300 between test jacks J201 and J202, and adjust the REF LEVEL potentiometer, R226, to obtain a reading of approximately 4.0 volts.

Step 4. Adjust the PHASE potentiometer, R225, for an on-course indication on the IN-10.

Step 5. Set the signal generator OMNI TRACK switch to 180°. The IN-10 vertical needle should remain centered (on-course); if not, readjust BAL potentiometer R239 to reduce the off-center error by one half.

Step 6. Repeat the adjustments of R225, at a 0° ANGLE TO track; and of R239, at a 180° track (Steps 3, 4, and 5, this paragraph); until an on-course indication is obtained at both 0° and 180°. Lock R239, taking care not to disturb its setting.

ADJUSTMENT OF COURSE SENSITIVITY. To adjust the course sensitivity, proceed as follows:

Step 1. Set the H-14 or H-14A OMNI TRACK switch at 0°, and set the IN-10 to 181.5°. Adjust the REF LEVEL control, R226, if necessary, to obtain a "five-dot" deflection of the IN-10 vertical needle to the right (yellow) side, which corresponds to 150 microamperes. Reset PHASE control R225 for an on-course indication, with the IN-10 set to 191.5°. Repeat the procedure if necessary.

Step 2. Measure the reference channel output voltage with the Ballantine Model 300 connected between test jacks J201 and J202. If it is not equal to the variable channel output (4 volts) within 0.5 volt, adjust the VAR LEVEL potentiometer, R250, to produce the required balancing of these outputs.

Note

As the variable channel output (J202 and J203) is raised, the reference channel output (J202 and J201) must be decreased (and vice versa) to maintain the proper off-course deflection of 10°. Therefore, the "5-dot" deflection for 10° off-course must be rechecked whenever the setting of either R226 or R250 is changed. If R250 was readjusted in this step, repeat Steps 4 and 5 of the reference channel and phase comparison circuit adjustment and then lock R239, R226, R225, and R250.

CHECK OF REFERENCE CHANNEL LIMITER AND OTHER CIRCUITS. Connect a Ballantine Model 300 between pin 7 of V203A and chassis ground. After the reference-channel and phase-comparison circuit adjustment and the course-sensitivity adjustment have been completed, a reading within the limits of 0.9 and 1.1 volts should be obtained if the reference channel circuits beyond this test point are functioning properly. Also, if the limiter and the 10-kc amplifier, V201A, are functioning properly, the voltage as read on the vtvm between pin 4 of V201A and chassis ground should be within the limits of 2.8 and 3.4 volts. If either or both of these voltages are out of limits, it is an indication of trouble.

ADJUSTMENT OF PHASE-SPLITTER NETWORK TO MINIMIZE QUADRANTAL ERRORS.

Caution

Do not attempt this critical adjustment unless R222 has been damaged, or R221 or C210 has been replaced, or the presence of excessive quadrantal error has been positively determined experimentally.

Adjust the phase-splitting network to minimize quadrantal error as follows:

Step 1. Set the H-14 or H-14A OMNI TRACK switch to 30° and adjust the IN-10 for an on-course indication of the vertical needle. The IN-10 should read very close to 222° (30° plus 191.5°; refer to paragraph 5–3). If it does not, subtract 222° from the actual reading and record the difference with proper algebraic sign.

Step 2. Set the signal generator OMNI TRACK switch to 60°. Readjust the IN-10 to approximately 252° for an on-course vertical needle indication, and again record the difference.

Step 3. Repeat the measurements of Step 2 for each successive 30° angle (that is, 90, 120, 150, etc.) around the OMNI TRACK switch, recording the errors of indication as in the previous steps.

Step 4. Plot a curve of errors as calculated (in degrees) against the setting of the OMNI TRACK switch. If the value of R222 is not optimum, an average curve similar to one of the curves shown in Figure 5–4 will result. In an ideal curve of this type, the peak-to-peak distance "h" of Figure 5–4 will be zero.

Note

Small random errors will cause the observed points to scatter around such an average curve. Attempt to average out such random errors in plotting the curve.

Step 5. If the peak-to-peak distance "h" of Figure 5–4 is not close to zero, reduce "h" to a minimum by

proceeding as follows: If the plotted curve is similar to A of Figure 5–4, *decrease* R222 by an amount equal to "h" (in degrees) x 10,000 ohms; if the plotted curve is similar to B of Figure 5–4, *increase* R222 by an amount equal to "h" (in degrees) x 10,000 ohms.

Step 6. After changing R222 by the amount calculated in Step 5, plot a new quadrantal error curve (Steps 1 through 4) to confirm the resultant value of R222.

Step 7. When the quadrantal error curve has been made as nearly a straight line as possible, set the signal generator OMNI TRACK switch to 90° and set the IN-10 to 282°.

Step 8. Unlock R225 and adjust it for an on-course vertical needle indication, or as required to give minimum error averaged around the compass degrees. Lock R225 taking care not to disturb its setting.

Step 9. Check for course accuracy around the full circle, and for flag alarm and to-from meter operation, as described in Table 5–2.

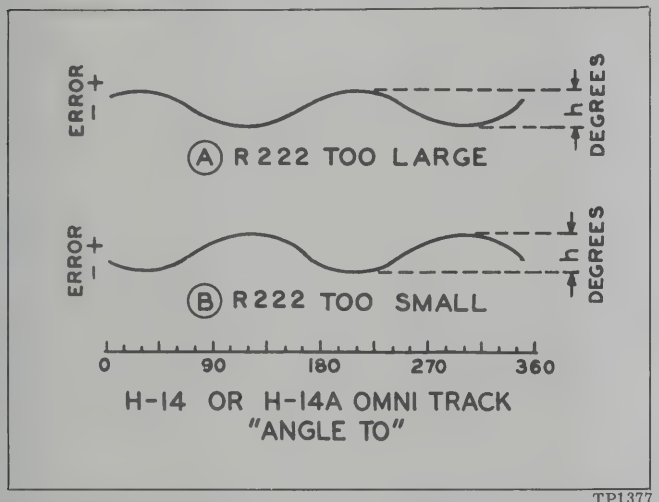

Figure 5–4. Example Curves of Quadrantal Error

Adjustment of VAR/LOC Section. To adjust the VAR/LOC section of the B-13A, proceed as follows:

Step 1. Interconnect the test equipment and the B-13A under test as shown in Figure 5–3.

Step 2. Set the control unit OMNI-VAR LOC switch to VAR LOC.

Step 3. Apply low-voltage power and allow the equipment to warm up for 15 minutes.

Step 4. Apply 1.8 volts of AMP LOC ◌ (needle center) modulation from the H-14 or H-14A Signal Generator to the receiver test harness EXT NAV MOD input.

Step 5. Set the SENS potentiometer, R257, at approximately a two-thirds clockwise position and adjust the BAL potentiometer, R264, to obtain an on-course indication on the IN-10. (R257 and R264 are located on the front panel of the B-13A.)

Step 6. Set the signal generator modulation to AMP LOC ◌ (needle left) and adjust R257 until the IN-10 vertical needle lies at the outer edge of the blue sector on the IN-10 dial. (This position corresponds to 90 microamperes. If desired, a 1000-ohm, 150-0-150 microammeter may be used in place of the IN-10 cross-pointer meter section.)

Step 7. Set the signal generator to AMP LOC ◌ (needle right). The vertical needle should lie at the outer edge of the yellow sector, plus or minus about one needle width. The equivalent meter current should be 90(±5) microamperes. If the needle differs from the specified deflection, readjust R257 to reduce the difference by one-half.

Step 8. Lock R257 and R264, taking care not to disturb their settings, and recheck all the AMP LOC needle settings of the signal generator. The on-course indication, at 0(±2) microamperes, should not be detectable in error; the "needle left" and "needle right" positions, at 85 to 95 microamperes meter current each, should be short of the ends of their respective colored sections by about two needle widths. Residual errors should be approximately balanced on both sides. In all settings, the flag alarm should be completely out of sight.

SECTION VI
DIAGRAMS

Figure 6–1. ARC Type R-32 Receiver, Schematic Diagram

Figure 6–2. ARC Type R-32 Receiver, Wiring Diagram

Figure 6–3. ARC Type B-13A Converter, Schematic Diagram

Figure 6–4. ARC Type B-13A Converter, Wiring Diagram

Figure 6–5. ARC Type E-16 Rack, Schematic Diagram

Figure 6–6. ARC Type E-16 Rack, Wiring Diagram

Figure 6–7. ARC Type E-17 Rack, Schematic Diagram

Figure 6–8. ARC Type E-17 Rack, Wiring Diagram

Figure 6–9. ARC Type E-18 Rack, Schematic Diagram

Figure 6–10. ARC Type E-18 Rack, Wiring Diagram

Figure 6–11. ARC Type C-1254A Control Unit, Schematic Diagram

Figure 6–12. ARC Type C-1254A Control Unit, Wiring Diagram

Figure 6–13. ARC Type C-22A Control Unit, Schematic Diagram

Figure 6–14. ARC Type C-22A Control Unit, Wiring Diagram

Figure 6–15. ARC Type IN-10 Course Indicator, Schematic Diagram

Figure 6–16. ARC Type R-32 Receiver, Voltage and Resistance Diagram

Figure 6–17. ARC Type B-13A Converter, Voltage and Resistance Diagram

Figure 6–18. ARC Type 15E Equipment with ARC Type T-20 Transmitter, System Schematic Diagram

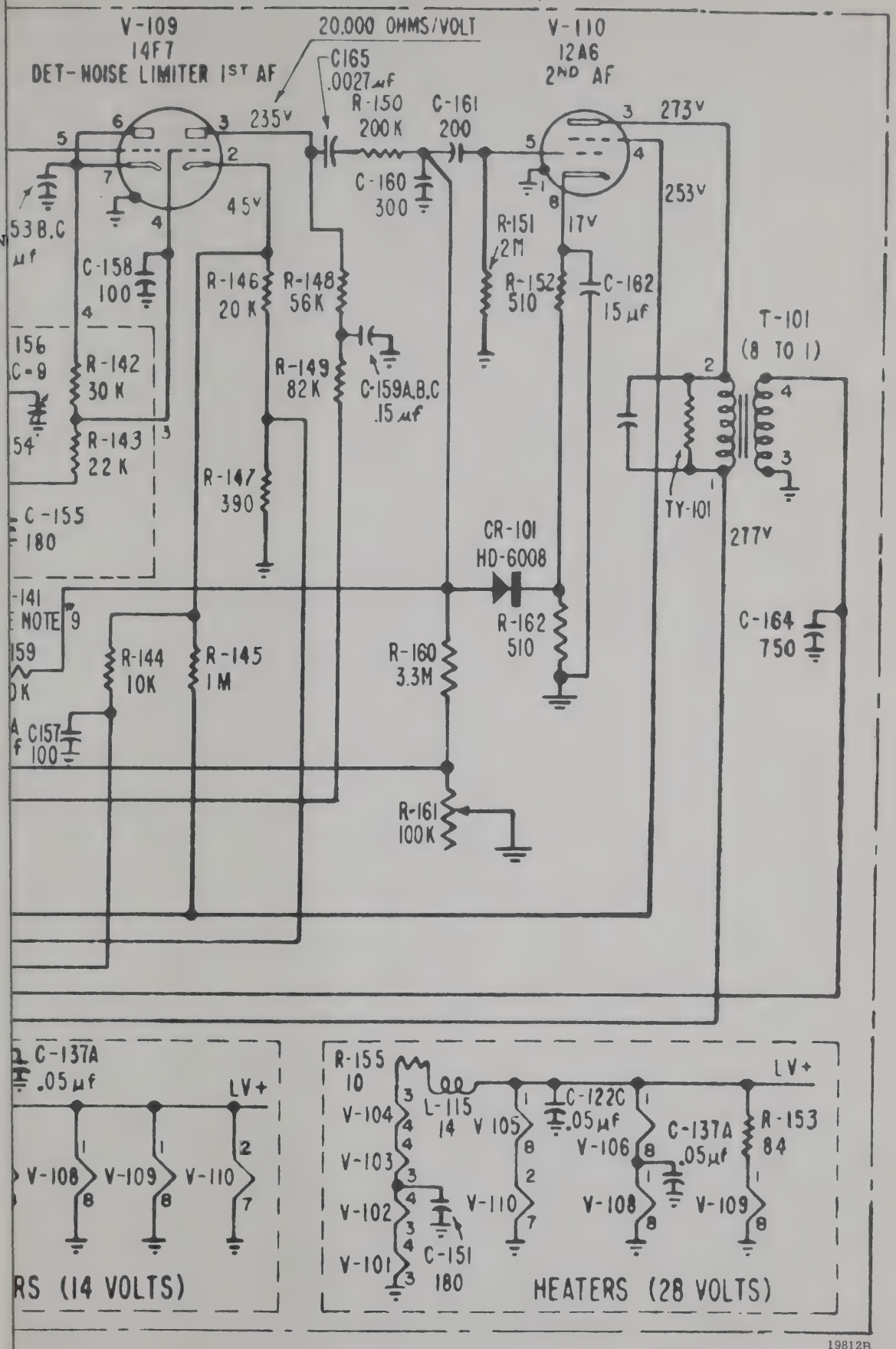

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Figure 6–1. ARC Type R-32 Receiver, Schematic Diagram

SECTION VI
DIAGRAMS

Figure 6–1. ARC Type R-32 Receiver, Schematic Diagram

Figure 6–2. ARC Type R-32 Receiver, Wiring Diagram

Figure 6–3. ARC Type B-13A Converter, Schematic Diagram

Figure 6–4. ARC Type B-13A Converter, Wiring Diagram

Figure 6–5. ARC Type E-16 Rack, Schematic Diagram

Figure 6–6. ARC Type E-16 Rack, Wiring Diagram

Figure 6–7. ARC Type E-17 Rack, Schematic Diagram

Figure 6–8. ARC Type E-17 Rack, Wiring Diagram

Figure 6–9. ARC Type E-18 Rack, Schematic Diagram

Figure 6–10. ARC Type E-18 Rack, Wiring Diagram

Figure 6–11. ARC Type C-1254A Control Unit, Schematic Diagram

Figure 6–12. ARC Type C-1254A Control Unit, Wiring Diagram

Figure 6–13. ARC Type C-22A Control Unit, Schematic Diagram

Figure 6–14. ARC Type C-22A Control Unit, Wiring Diagram

Figure 6–15. ARC Type IN-10 Course Indicator, Schematic Diagram

Figure 6–16. ARC Type R-32 Receiver, Voltage and Resistance Diagram

Figure 6–17. ARC Type B-13A Converter, Voltage and Resistance Diagram

Figure 6–18. ARC Type 15E Equipment with ARC Type T-20 Transmitter, System Schematic Diagram

NOTES

1. CONNECTIONS ARE SHOWN TO WIRED SIDE OF RECEPTACLES.
2. ALL CAPACITOR VALUES ARE IN MICROMICROFARADS (uuf) UNLESS OTHERWISE NOTED.
3. ALL RESISTOR VALUES ARE IN OHMS. MULTIPLIER K = 1,000, M = 1,000,000.
4. ALL INDUCTOR VALUES ARE IN MICROHENRIES UNLESS OTHERWISE NOTED.
5. THE INTERMEDIATE FREQUENCY (IF) IS 15 MC (RF OSCILLATOR FREQUENCY IS 15 MC LESS THAN RF SIGNAL FREQUENCY).
6. DC VOLTAGES ARE APPROXIMATE AND ARE BASED ON THE FOLLOWING CONDITIONS.
   (a) NEGATIVE TERMINAL OF VOLTMETER GROUNDED TO CHASSIS.
   (b) LV + AT TERMINAL "2" OF J-104 SET AT 13.5 VOLTS (FOR 14V RECEIVER) OR 27 VOLTS (FOR 28V RECEIVER) BY ADJUSTMENT OF LV + SOURCE.
   (c) SENSITIVITY LINE (TERMINAL "3" OF J-103) GROUNDED; NO SIGNAL INPUT.
   (d) VOLTMETER-OHMS-PER-VOLT: EITHER 1,000 OR 20,000 EXCEPT WHERE SPECIFICALLY INDICATED.
   (e) HV VOLTAGE IN PARENTHESES IS THAT OBTAINED WHEN DYNAMOTOR SUPPLIES 130ma TO A TRANSMITTER CONNECTED TO J-105; NO RECEIVER DRAIN.
   (f) VOLTAGES SHOWN WILL BE LOWERED APPROXIMATELY 5% WHEN DYNAMOTOR SUPPLIES 14ma TO A CONVERTER IN ADDITION TO THE NORMAL RECEIVER DRAIN OF 70ma.
7. FOR WIRING DIAGRAM SEE FIGURE 6-2.
8. THE VALUE OF THE COMPONENTS BELOW ARE SELECTED AND INSTALLED AT TIME OF FINAL ADJUSTMENT

SYMBOL NO.	LIMITING VALUES	PURPOSE
R-141	56K TO 180K	PHASE SHIFT AT 30 CPS
R-130	0-2 0M	AF VOLTAGE TO CONVERTER

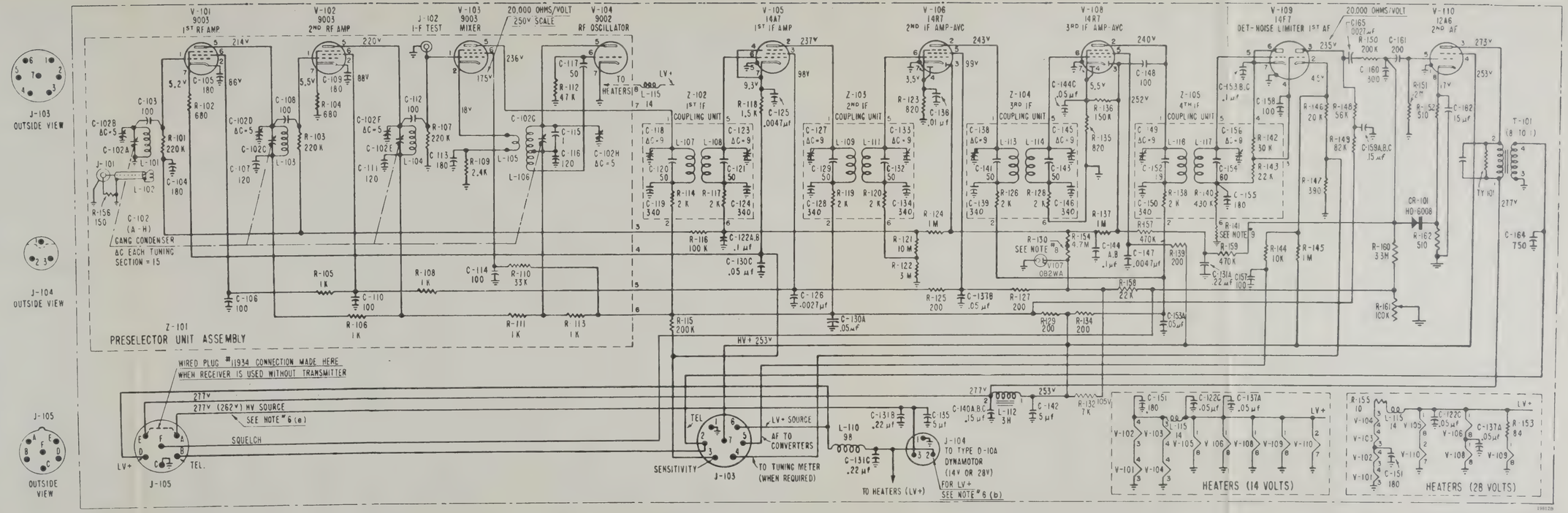


Figure 6-1. ARC Type R-32 Receiver, Schematic Diagram

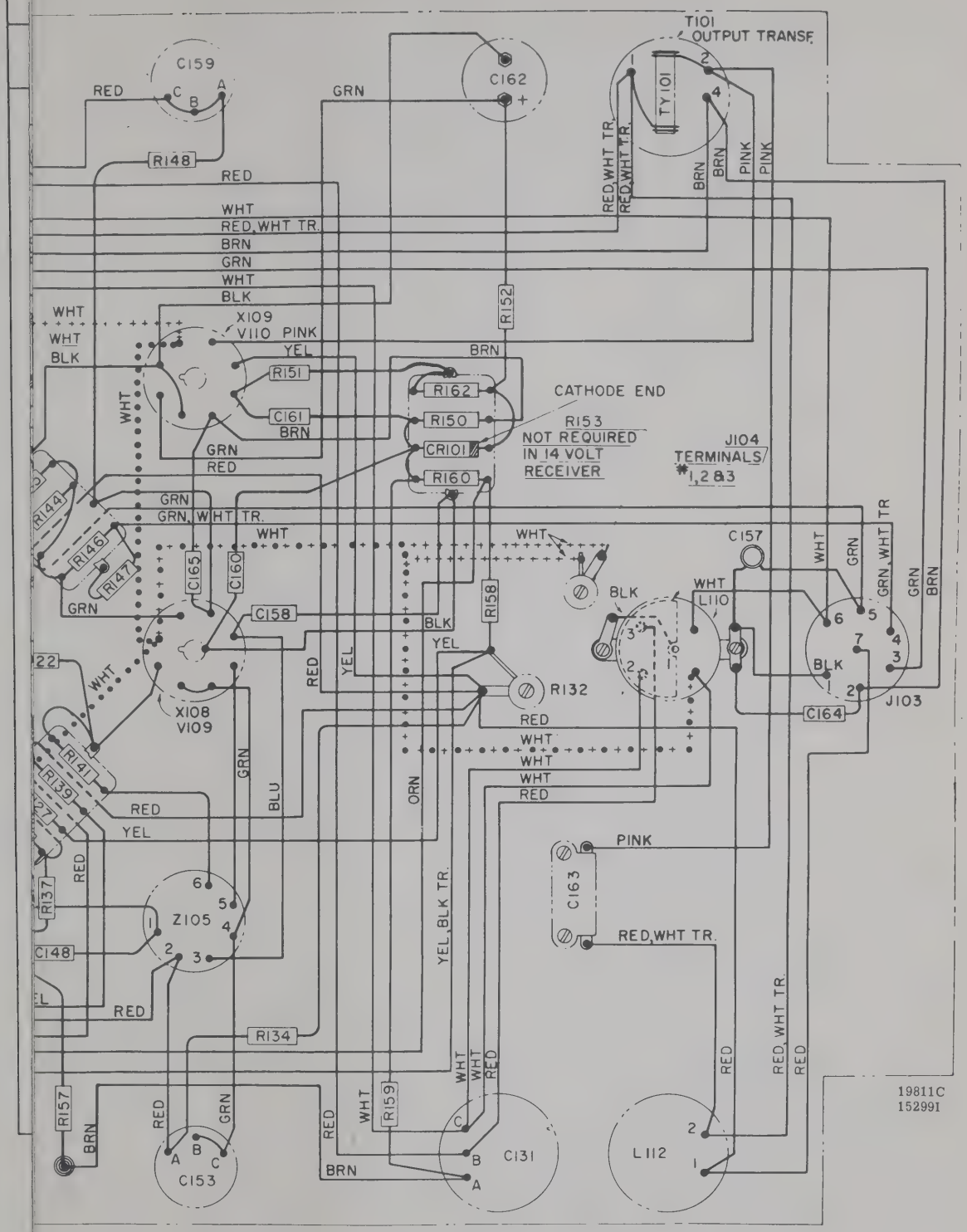


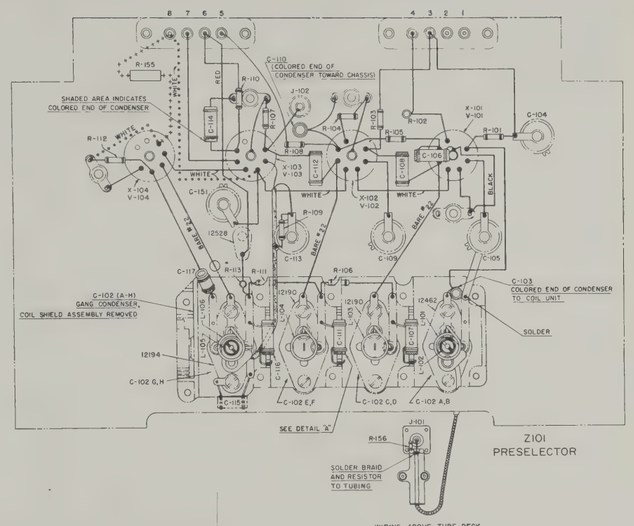
Figure 6–2. ARC Type R-32 Receiver, Wiring Diagram

SYMBOL IDENTIFICATION TABLE
MULTIPLIERS FOR RESISTANCE VALUES: K = 1,000, MEG = 1,000,000

SYMBOL NO.	DRAWING NO.	DESCRIPTION	SYMBOL NO.	DRAWING NO.	DESCRIPTION	SYMBOL NO.	DRAWING NO.	DESCRIPTION
C102(A-H)	11859	4 SECTION GANG	C163	4089	.002 uf	R144	201	10 K OHMS
C103	4520	100 uuf	C164	4522	750 uuf	R145	201	1 MEG OHMS
C104	14600	180 uuf				R146	201	20 K OHMS
C105	14600	180 uuf	CR101	1953	HD6008	R147	201	390 OHMS
C106	4520	100 uuf				R148	201	56 K OHMS
C107	8013	120 uuf	J101		PART OF ASSEMBLY 12449	R149	201	82 K OHMS
C108	4520	100 uuf	J102	12533	I-F TEST JACK	R150	201	200 K OHMS
C109	14600	180 uuf	J103		PART OF CHASSIS ASSEMBLY	R151	201	2 MEG OHMS
C110	4520	100 uuf	J104		PART OF CHASSIS ASSEMBLY	R152	201	510 OHMS
C111	8013	120 uuf	J105	11905	RECEPTACLE ASSEMBLY	R153 (14 V)	NOT USED	
C112	4520	100 uuf				R153 (28 V)	8066	84 OHMS
C113	14600	180 uuf	L101		PART OF ANTENNA COIL	R154	204	4.7 MEG OHMS
C114	4520	100 uuf	L102		UNIT ASSEMBLY 12402	R155	201	10 OHMS
C115		PART OF ASSEMBLY 12194	L103		PART OF ASSEMBLY 12190	R156	204	150 OHMS
C116	8013	120 uuf	L104		PART OF ASSEMBLY 12190	R157	205	47 K OHMS
C117	8091	50 uuf	L105		PART OF OSCILLATOR	R158	201	22 K OHMS
C122A		.05 uf	L106		COIL UNIT ASSEMBLY 12194	R159	201	470 K OHMS
C122B	5414	.05 uf	L110	5546	R-F CHOKE 98 uh	R160	201	3.3 MEG OHMS
C122C		.09 uf	L112	5634	A-F CHOKE 3 h	R161	8825	0-100 K OHMS
C125	8516	.0047 uf	L115	15174	R-F CHOKE 14 uh	R162	201	510 OHMS
C126	8554	.0027 uf						
C130A		.05 uf	R101	204	220 K OHMS			
C130B	5414	NOT USED	R102	204	680 OHMS	T101	15563	TRANSFORMER
C130C		.05 uf	R103	204	220 K OHMS			
C131A		.22 uf	R104	204	680 OHMS	TY101	8505	RESISTOR
C131B	5413	.22 uf	R105	204	1 K OHMS			
C131C		.22 uf	R106	204	1 K OHMS	V101	9003	VACUUM TUBE
C135	6350	.5 uf	R107	204	220 K OHMS	V102	9003	VACUUM TUBE
C136	8283	.01 uf	R108	204	1 K OHMS	V103	9003	VACUUM TUBE
C137A		.05 uf	R109	204	2.4 K OHMS	V104	9002	VACUUM TUBE
C137B	5414	.05 uf	R110	204	33 K OHMS	V105	14A7	VACUUM TUBE
C137C		NOT USED	R111	204	1 K OHMS	V106	14R7	VACUUM TUBE
C140A		.05 uf	R112	204	47 K OHMS	V107	OB2WA	V.R. TUBE
C140B	5414	.05 uf	R113	204	1 K OHMS	V108	14R7	VACUUM TUBE
C140C		.05 uf	R115	201	200 K OHMS	V109	14P7	VACUUM TUBE
C142	6350	.5 uf	R116	201	100 K OHMS	V110	12A6	VACUUM TUBE
C144A		.05 uf	R118	201	1.5 K OHMS			
C144B	11912	.05 uf	R121	201	10 MEG OHMS	X101	10298	TUBE SOCKET
C144C		.05 uf	R122	201	3 MEG OHMS	X102	10298	TUBE SOCKET
C147	8516	.0047 uf	R123	201	820 OHMS	X103	10298	TUBE SOCKET
C148	4520	100 uuf	R124	201	1 MEG OHMS	X104	10298	TUBE SOCKET
C151	14600	180 uuf	R125	201	200 OHMS	X105	12292	TUBE SOCKET
C153A		.05 uf	R127	201	200 OHMS	X106	12292	TUBE SOCKET
C153B	14661	.05 uf	R129	201	200 OHMS	X107	12292	TUBE SOCKET
C153C		.05 uf	R130	201	SEE NOTE NO. 9	X108	12292	TUBE SOCKET
C157	4520	100 uuf	R132	5895	7 K OHMS	X109	6559	TUBE SOCKET
C158	4520	100 uuf	R133	5895	7 K OHMS	X110	22052	SOCKET ASSEMBLY
C159A		.05 uf	R134	201	200 OHMS			
C159B	5414	.05 uf	R135	201	820 OHMS	Z101	12457	PRESELECTOR UNIT
C159C		.05 uf	R136	204	150 K OHMS	Z102	12195	1-F COUPLING UNIT
C160	8592	300 uuf	R137	205	1 MEG OHMS	Z103	12196	1-F COUPLING UNIT
C161	4513	200 uuf	R139	201	200 OHMS	Z104	12197	1-F COUPLING UNIT
C162	5416	15 uf	R141	201	SEE NOTE NO. 8	Z105	15659	1-F COUPLING UNIT

NOTES:

1. FOR SCHEMATIC DIAGRAM SEE FIGURE 6-1.
2. ALL WIRES MARKED WITH COLOR NOTE ARE NO. 22 SOLID TINNED COPPER, WITH VINYLITE INSULATION.
3. ALL UNMARKED WIRES ARE NO. 22 BARE TINNED SOLID COPPER.
4. VINYLITE TUBING OF APPROPRIATE SIZE IS INSTALLED OVER LEADS MARKED "T".
5. FOR 28-VOLT RECEIVER, WIRES MARKED (++++) ARE CONNECTED AND WIRES MARKED (.....) ARE OMITTED.
6. FOR 14-VOLT RECEIVER, WIRES MARKED (.....) ARE CONNECTED AND WIRES MARKED (++++) ARE OMITTED.
7. SHADED AREA ON CERAMIC CAPACITORS INDICATES COLORED END.
8. VALUE OF R141 IS DETERMINED AT TIME OF FINAL FACTORY OR OVERHAUL ADJUSTMENT, AND IS SELECTED FROM THE FOLLOWING VALUES: 56K, 75K, 91K, 110K, 130K, 150K, 160K, 180K.
9. VALUE OF R130 IS DETERMINED AT TIME OF FINAL FACTORY OR OVERHAUL ADJUSTMENT, AND IS SELECTED FROM THE FOLLOWING VALUES: 0, 200K, 390K, 560K, 750K, 1MEG, 1.2MEG, 1.5MEG, 1.8MEG, 2MEG.


8 7 6 5
4 3 2 1
SHADED AREA INDICATES COLORED END OF CONDENSER
C-110 (COLORED END OF CONDENSER TOWARD CHASSIS)
C-102 (A-H) GANG CONDENSER, COIL SHIELD ASSEMBLY REMOVED
C-103 COLORED END OF CONDENSER TO COIL UNIT
SOLDER
SEE DETAIL 'A'
SOLDER BRAID AND RESISTOR TO TUBING
Z101 PRESELECTOR
WIRING ABOVE TUBE DECK. (VIEW FROM REAR)
1/16 CLEARANCE BETWEEN WRAPPED LEADS OF C-107, C-111 & C-116 AND FEET OF GANG CONDENSER FRAME.
DETAIL 'A'

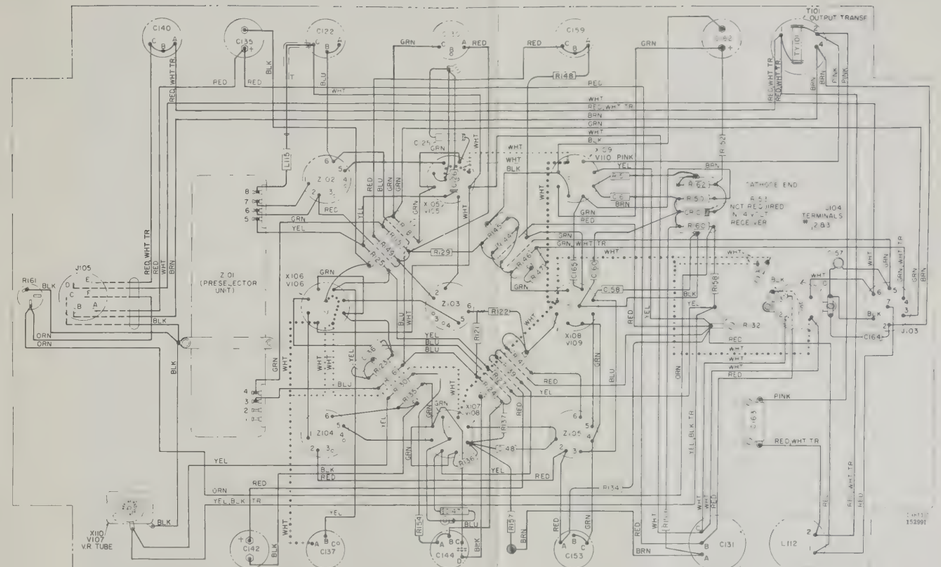


Figure 6-2. ARC Type R-32 Receiver, Wiring Diagram

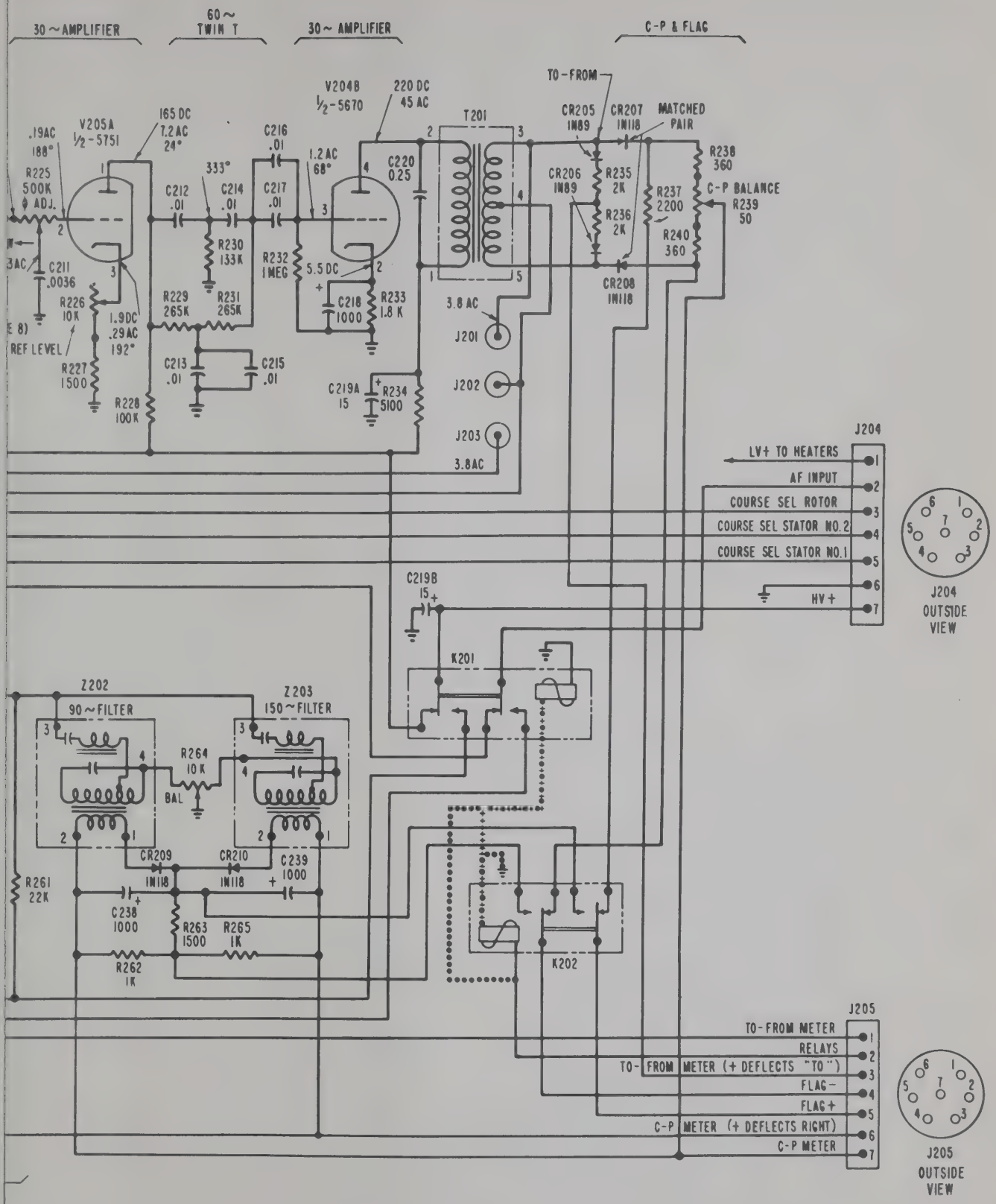


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Figure 6–3. ARC Type B-13A Converter, Schematic Diagram

NOTES:

1. FOR WIRING DIAGRAM, SEE FIGURE 6-4.
2. ALL CAPACITOR VALUES ARE IN MICROFARADS UNLESS OTHERWISE NOTED.
3. ALL RESISTOR VALUES ARE IN OHMS. MULTIPLIERS: K = 1,000 AND MEG = 1,000,000.
4. FOR 28-VOLT POWER SOURCE, WIRES MARKED (++++) ARE CONNECTED AND WIRES MARKED (....) ARE OMITTED.
5. FOR 14-VOLT POWER SOURCE, WIRES MARKED (....) ARE CONNECTED AND WIRES MARKED (++++) ARE OMITTED.
6. A-C AND D-C VOLTAGES ARE APPROXIMATE AND ARE BASED ON THE FOLLOWING CONDITIONS:
   A. D-C VOLTAGES ARE OBTAINED WITH A 20,000 OHMS-PER-VOLT VOLTMETER AND WITH LV+ SET AT THE NOMINAL SUPPLY VOLTAGE OF 14 VOLTS OR 28 VOLTS. VOLTAGES WILL BE A LITTLE HIGHER FOR 28-VOLT EQUIPMENT THAN FOR 14-VOLT EQUIPMENT.
   B. A-C VOLTAGES ARE OBTAINED WITH A BALLANTINE MODEL 300 ELECTRONIC VOLTMETER. VOLTAGES ARE MEASURED TO GROUND WITH THE EXCEPTION OF T201 and T202 SECONDARY VOLTAGES WHICH ARE MEASURED TO COMMON CENTER TAP.
7. ARROWS ON GERMANIUM DIODES SHOW DIRECTION OF CURRENT FLOW.
8. VALUE OF COMPONENTS LISTED BELOW ARE SELECTED AND INSTALLED AT TIME OF FINAL ADJUSTMENT:

SYMBOL NO.	LIMITING VALUE	PURPOSE
R222	0-20K	MINIMIZE QUADRANTAL ERROR
C240	0- .002 uF	CENTER PHASE ADJUSTING CONTROL

9. RELATIVE PHASE ANGLES OF VARIOUS 30-CPS VOLTAGES ARE MEASURED WITH RESPECT TO THE A-F INPUT VOLTAGE WITH THE SELECTOR SET AT (191°) PRODUCING AN "ON COURSE TO" INDICATION.

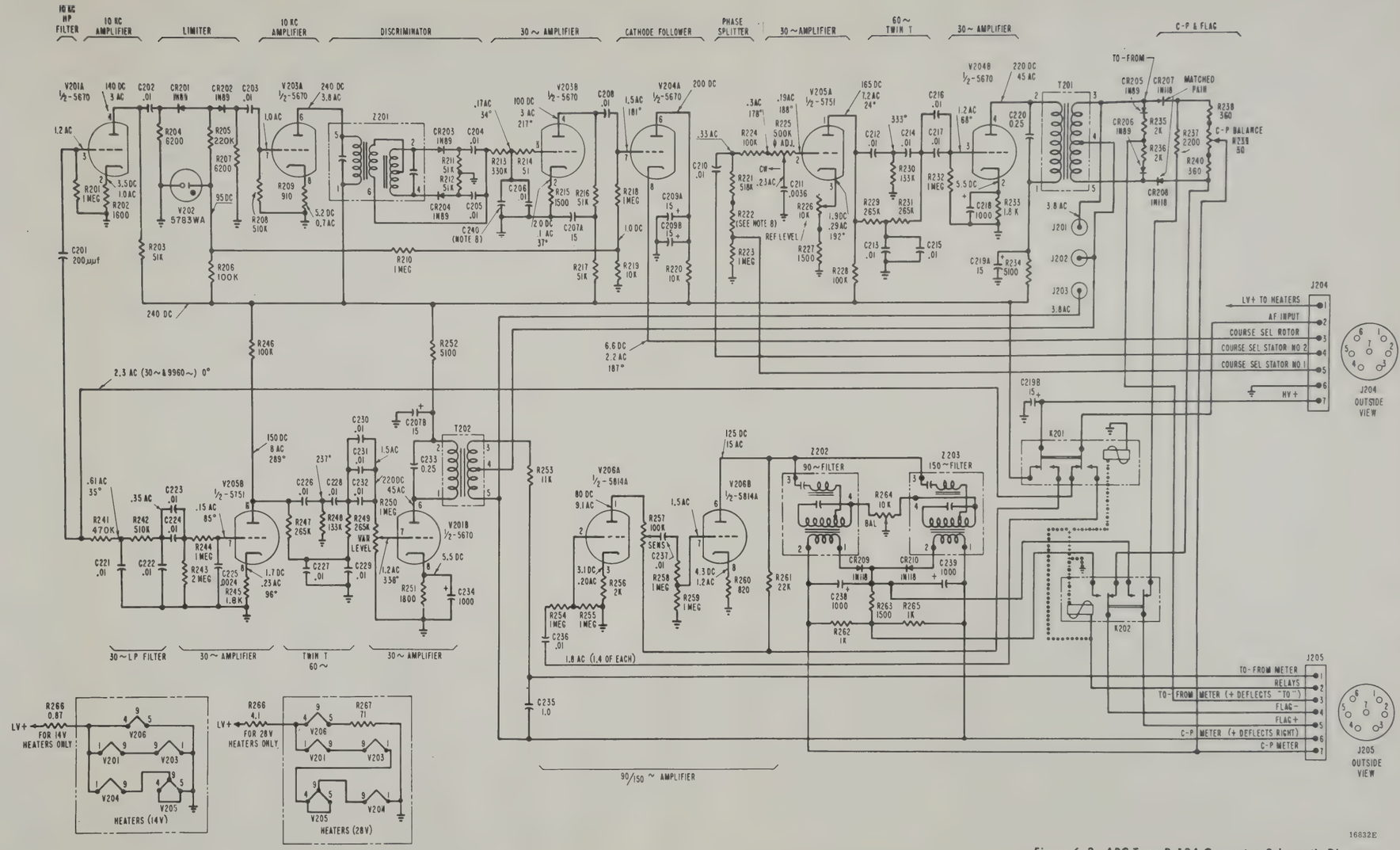

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Figure 6–3. ARC Type B-13A Converter, Schematic Diagram

SYMBOL NO.	DR
C201	8
C202	8
C203	8
C204	8
C205	8
C206	8
C207A	13
C207B	
C208	8
C209A	13
C209B	
C210	8
C211	8
C212	8
C213	8
C214	8
C215	8
C216	8
C217	8
C218	16
C219A	13
C219B	
C220	15
C221	8
C222	8
C223	8
C224	8
C225	8
C226	8
C227	8
C228	8
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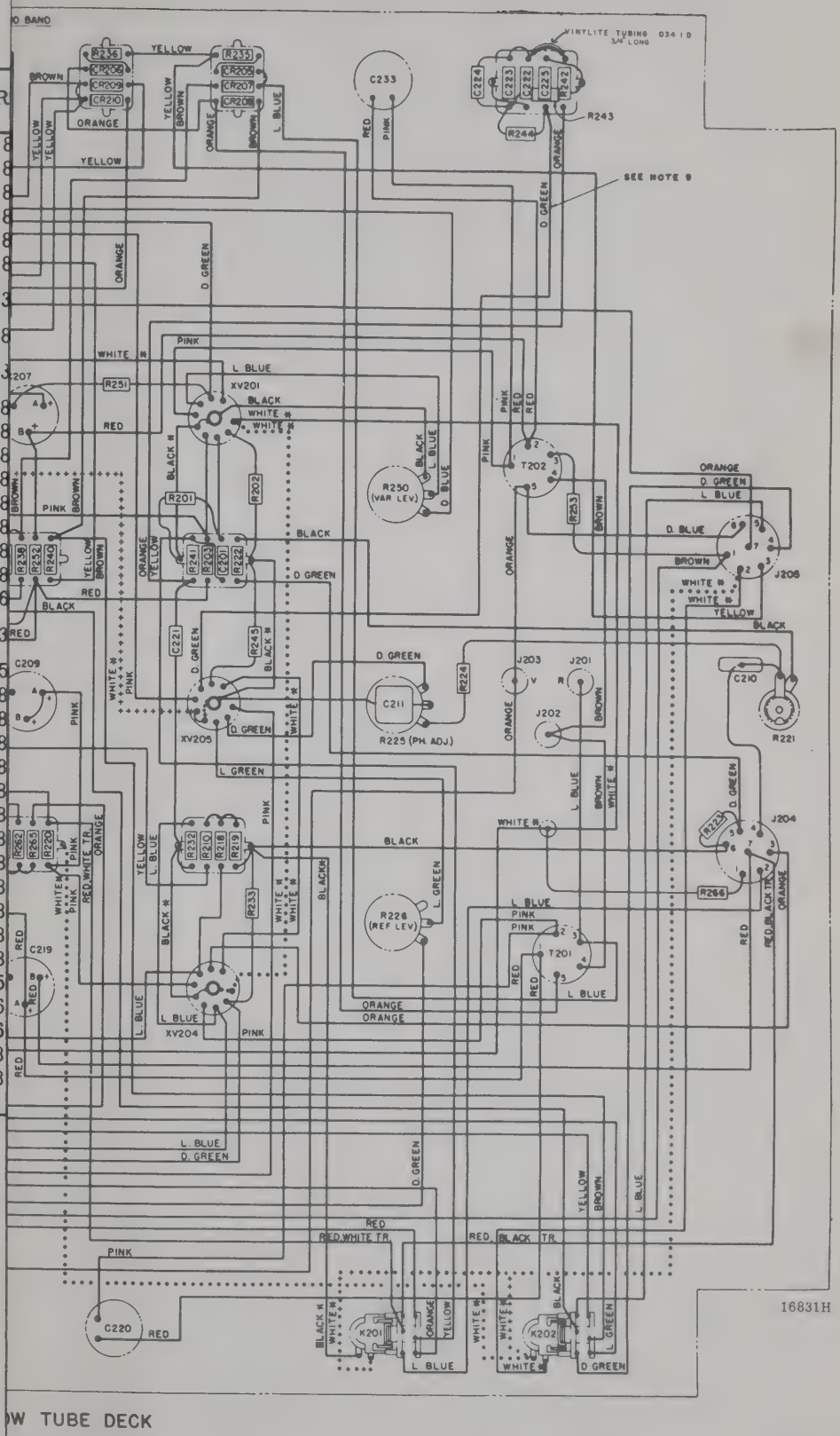
C233	15
C234	16
C235	16
C236	8
C237	8



W TUBE DECK

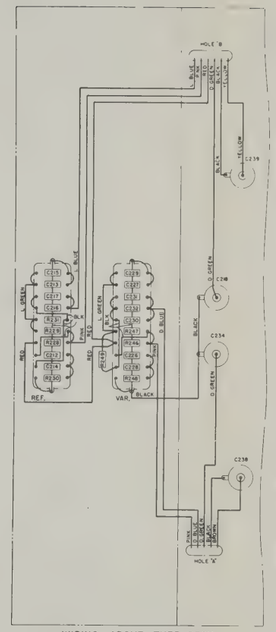
Figure 6–4. ARC Type B-13A Converter, Wiring Diagram

SYMBOL IDENTIFICATION TABLE
MULTIPLIERS FOR RESISTANCE VALUES: K = 1000, MEG = 1,000,000

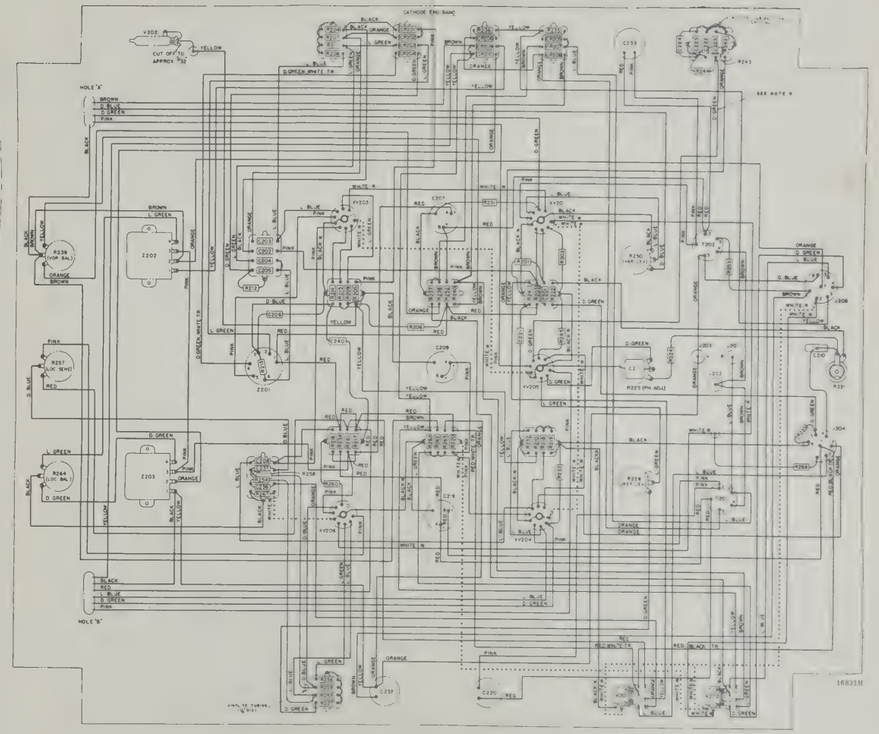
SYMBOL NO.	DRAWING NO.	DESCRIPTION	SYMBOL NO.	DRAWING NO.	DESCRIPTION	SYMBOL NO.	DRAWING NO.	DESCRIPTION	SYMBOL NO.	DRAWING NO.	DESCRIPTION
C201	8617	200 uuf	C238	16143	1000 uf	R217	201	51K OHMS	R257	8662	100K OHMS VARIABLE
C202	8577	.01 uf	C239	16143	1000 uf	R218	205	1MEG OHMS	R258	204	1MEG OHMS
C203	8577	.01 uf	C240	8617 OR 8618	SEE NOTE 8	R219	201	10K OHMS	R259	205	1MEG OHMS
C204	8577	.01 uf				R220	201	10K OHMS	R260	201	820 OHMS
C205	8577	.01 uf	CR201	16660	IN89 RECTIFIER	R221	8578	518K OHMS	R261	201	22K OHMS
C206	8577	.01 uf	CR202	16660	IN89 RECTIFIER	R222	201	SEE NOTE 7	R262	201	1K OHMS
C207A	13928	15 uf	CR203	16660	IN89 RECTIFIER	R223	201	1M OHMS	R263	201	1.5K OHMS
C207B		15 uf	CR204	16660	IN89 RECTIFIER	R224	205	100K OHMS	R264	8573	10K OHMS VARIABLE
C208	8577	.01 uf	CR205	16660	IN89 RECTIFIER	R225	8247	0.5 MEG OHMS VARIABLE	R265	201	1K OHMS
C209A	13928	15 uf	CR206	16660	IN89 RECTIFIER	R226	8573	10K OHMS VARIABLE	R266	16643	0.87 OHMS FOR 14V
C209B		15 uf	CR207	16670	IN118 RECTIFIER	R227	201	1.5K OHMS		16644	4.1 OHMS FOR 28V
C210	8577	.01 uf	CR208		IN118 RECTIFIER	R228	201	100K OHMS	R267	8664	71 OHMS
C211	8618	.0036 uf	CR209	16665	IN118 RECTIFIER	R229	205	265K OHMS			
C212	8577	.01 uf	CR210	16665	IN118 RECTIFIER	R230	205	1MEG OHMS			
C213	8577	.01 uf				R231	205	265K OHMS			
C214	8577	.01 uf	J201	13152	JACK ASSEMBLY	R232	201	1MEG OHMS	T201	15610	TRANSFORMER
C215	8577	.01 uf	J202	12921	JACK ASSEMBLY	R233	201	1.8K OHMS	T202	15610	TRANSFORMER
C216	8577	.01 uf	J203	13152	JACK ASSEMBLY	R234	201	5.1K OHMS			
C217	8577	.01 uf	J204	5488	PLUG ASSEMBLY	R235	201	2K OHMS	V201	5670	VACUUM TUBE
C218	16143	1000 uf	J205	5488	PLUG ASSEMBLY	R236	201	2K OHMS	V202	5783 WA	V.R. TUBE
C219A	13928	15 uf				R237	201	2.2K OHMS	V203	5670	VACUUM TUBE
C219B		15 uf	K201	12712	RELAY 14V	R238	205	360 OHMS	V204	5670	VACUUM TUBE
C220	15763	0.25 uf	K202	12712	RELAY 14V	R239	8654	50 OHMS VARIABLE	V205	5751	VACUUM TUBE
C221	8577	.01 uf				R240	205	360 OHMS	V206	5814A	VACUUM TUBE
C222	8577	.01 uf	R201	201	1MEG OHMS	R241	205	470K OHMS			
C223	8577	.01 uf	R202	201	1.6K OHMS	R242	205	510K OHMS	XV201	15230	SCCKET 9 PIN
C224	8577	.01 uf	R203	201	51K OHMS	R243	201	2MEG OHMS	XV203	15230	SOCKET 9 PIN
C225	8618	.0024 uf	R204	201	6.2K OHMS	R244	205	1MEG OHMS	XV204	15230	SOCKET 9 PIN
C226	8577	.01 uf	R205	201	220K OHMS	R245	201	1.8K OHMS	XV205	15230	SOCKET 9 PIN
C227	8577	.01 uf	R206	201	100K OHMS	R246	201	100K OHMS	XV206	15230	SCCKET 9 PIN
C228	8577	.01 uf	R207	201	6.2K OHMS	R247	205	265K OHMS			
C229	8577	.01 uf	R208	201	510K OHMS	R248	205	143K OHMS			
C230	8577	.01 uf	R209	201	910 OHMS	R249	205	265K OHMS	Z201	15374	DISCRIMINATOR
C231	8577	.01 uf	R210	201	1MEG OHMS	R250	8655	100K OHMS VARIABLE	Z202	15890	90-CPS BP FILTER
C232	8577	.01 uf	R211	201	51K OHMS	R251	201	1.8K OHMS	Z203	15891	150-CPS BP FILTER
C233	15763	0.25 uf	R212	201	51K OHMS	R252	201	5.1K OHMS			
C234	16143	1000 uf	R213	205	330K OHMS	R253	201	11K OHMS			
C235	16653	1.0 uf	R214	201	51 OHMS	R254	204	1MEG OHMS			
C236	8577	.01 uf	R215	201	1.5K OHMS	R255	205	1MEG OHMS			
C237	8577	.01 uf	R216	201	51K OHMS	R256	201	2K OHMS			

NOTES:

1. FOR SCHEMATIC DIAGRAM, SEE FIGURE 6-3.
2. ALL WIRES MARKED WITH COLOR NOTE ARE NO. 24, VINYLITE INSULATION EXCEPT THOSE MARKED WITH AN ASTERISK (*), WHICH ARE NO. 22 VINYLITE INSULATION.
3. ALL UNMARKED WIRES ARE NO. 22 BARE TINNED COPPER.
4. FOR 28-VOLT POWER SOURCE, WIRES MARKED (++++) ARE CONNECTED AND WIRES MARKED (.....) ARE OMITTED.
5. FOR 14-VOLT POWER SOURCE, WIRES MARKED (.....) ARE CONNECTED AND WIRES MARKED (++++) ARE OMITTED.
6. RESISTOR R267 USED ON 28-VOLT EQUIPMENT ONLY.
7. VALUE OF R222 IS DETERMINED AT TIME OF FINAL FACTORY OR OVERHAUL ADJUSTMENT, AND IS SELECTED FROM THE FOLLOWING VALUES: 0, 5100, 10K, 15K, 20K.
8. VALUE OF C240 IS DETERMINED AT TIME OF FINAL FACTORY OR OVERHAUL ADJUSTMENT, AND IS SELECTED FROM THE BEST RMA VALUES BETWEEN 0 and .002 uf.
9. LAY WIRE DIRECTLY AGAINST CHASSIS.

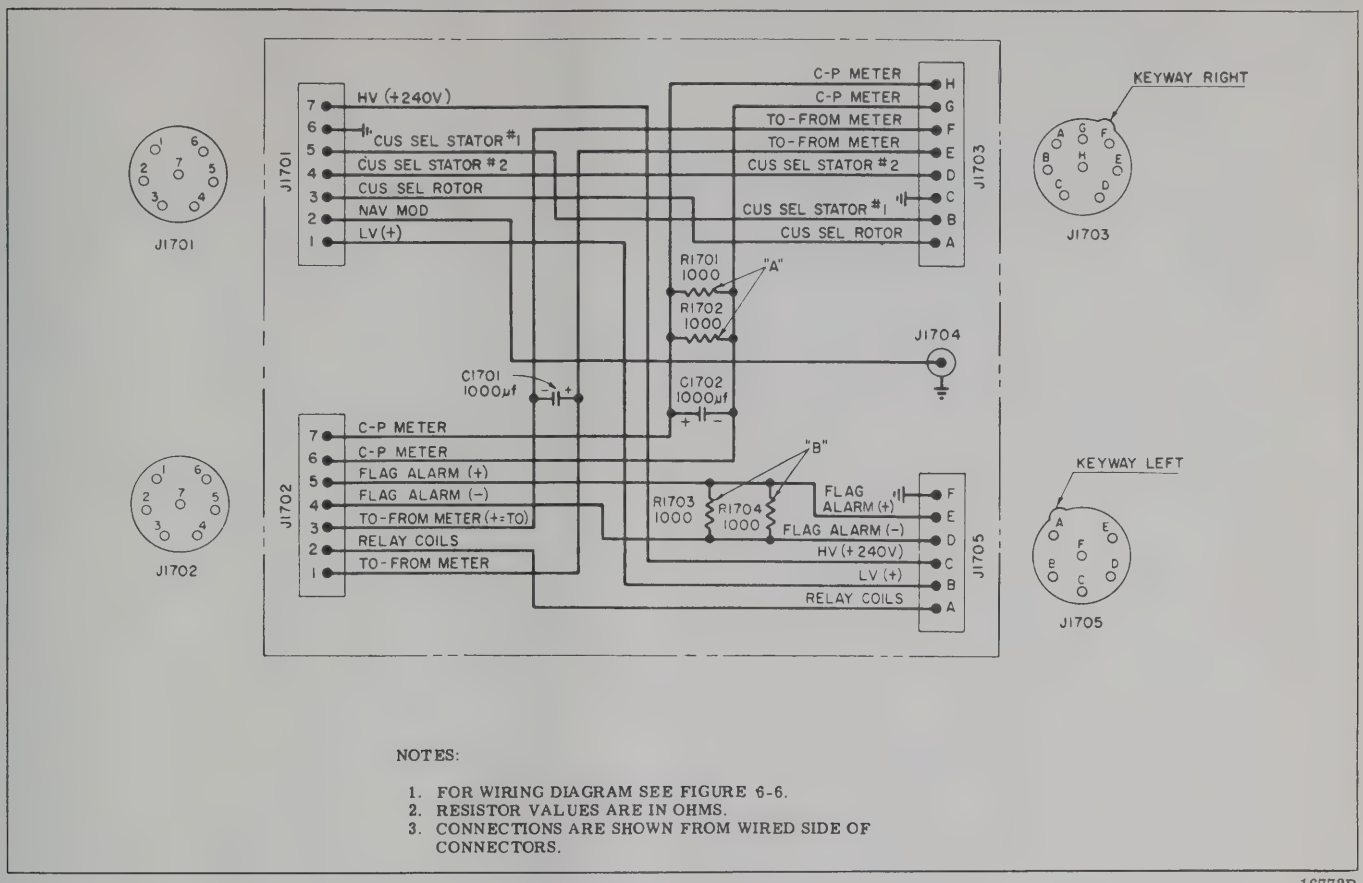


WIRING ABOVE TUBE DECK



WIRING BELOW TUBE DECK

Figure 6-4. ARC Type B-13A Converter, Wiring Diagram



NOTES:

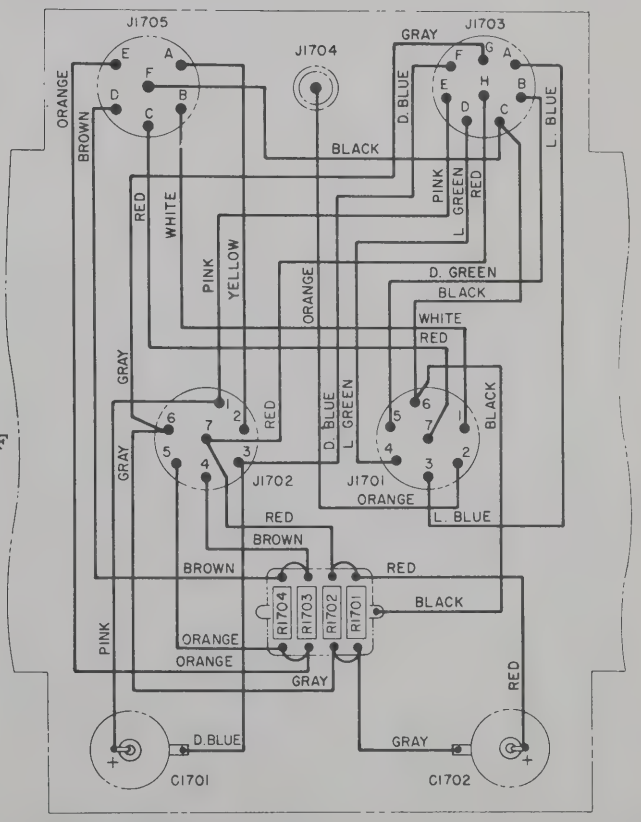
1. FOR WIRING DIAGRAM SEE FIGURE 6-6.
2. RESISTOR VALUES ARE IN OHMS.
3. CONNECTIONS ARE SHOWN FROM WIRED SIDE OF CONNECTORS.

16772B

Figure 6–5. ARC Type E-16 Rack, Schematic Diagram

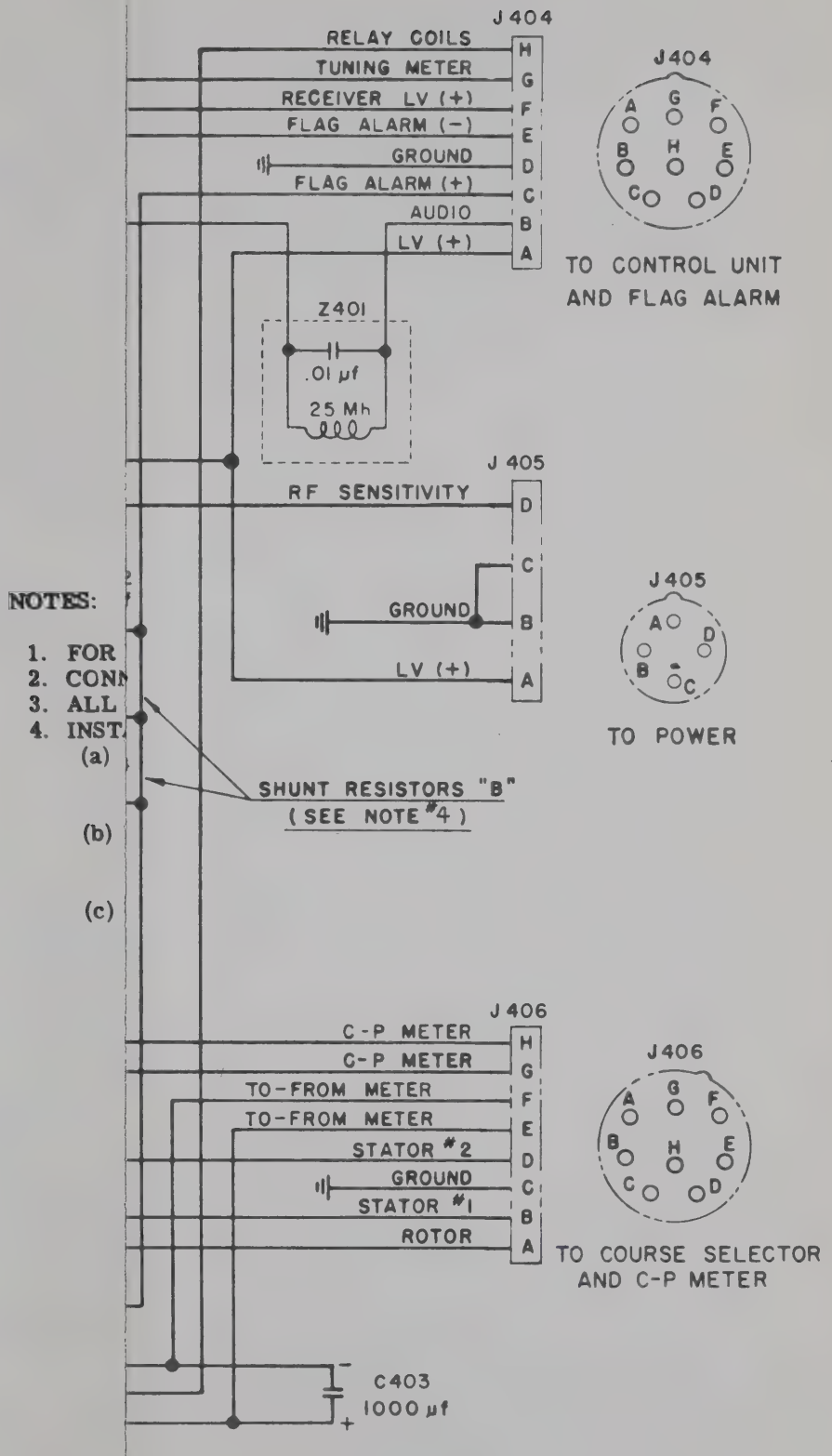
NOTES:

1. FOR SCHEMATIC DIAGRAM SEE FIGURE 6-5.
2. ALL WIRES ARE NO. 22 SOLID COPPER.
3. CONNECTIONS ARE SHOWN FROM WIRED SIDE OF CONNECTORS.



16771B

Figure 6–6. ARC Type E-16 Rack, Wiring Diagram

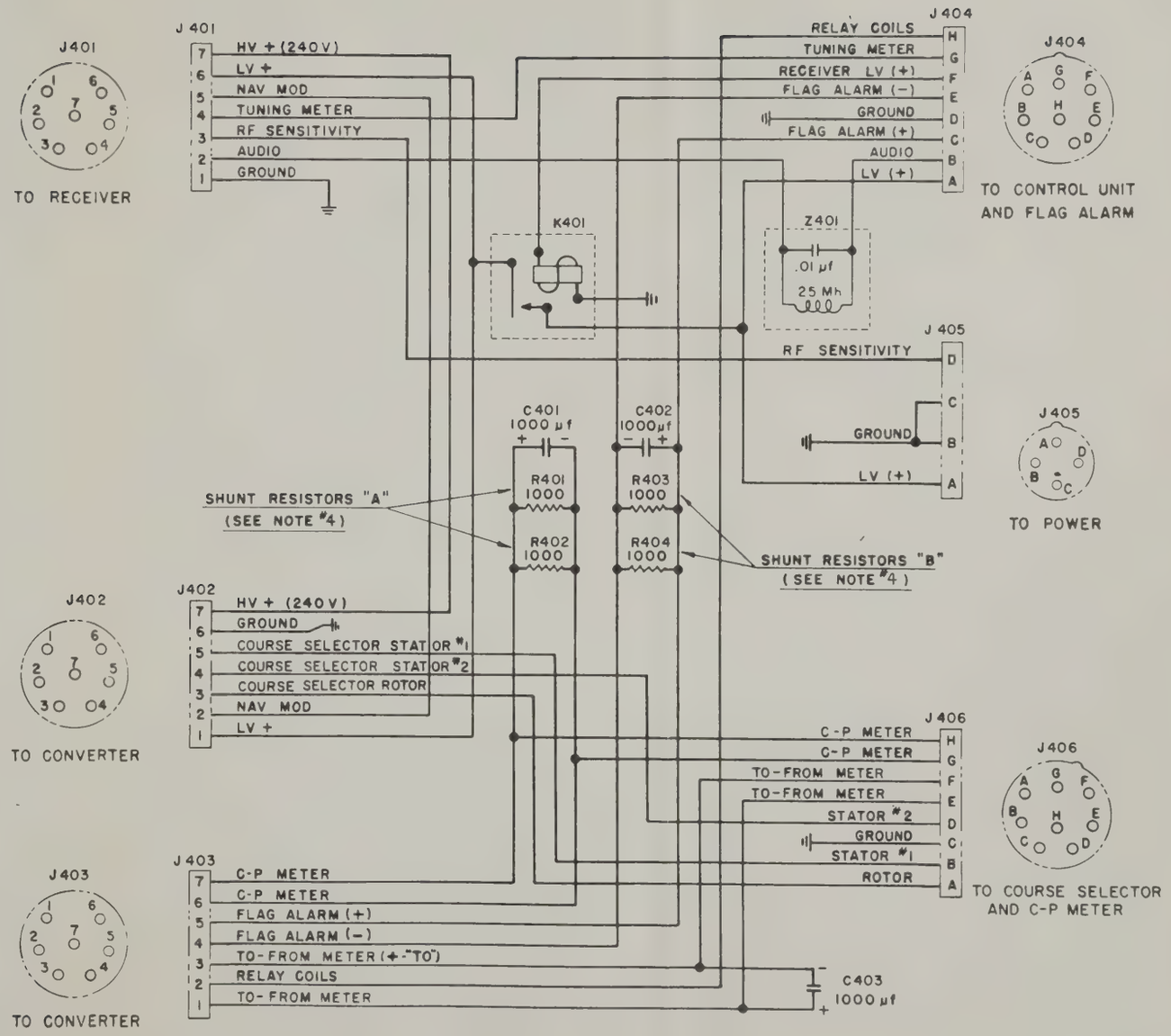


19802B

Figure 6–7. ARC Type E-17 Rack, Schematic Diagram

NOTES:

1. FOR WIRING DIAGRAM SEE FIGURE 6-8.
2. CONNECTORS ARE SHOWN AS SEEN FROM OUTSIDE.
3. ALL RESISTOR VALUES ARE IN OHMS.
4. INSTALLATION OF RESISTORS:
   (a) WITH SHUNT RESISTORS "A" AND "B" AS SHOWN THE SYSTEM IS ADJUSTED TO FEED ONE VERTICAL POINTER AND ONE FLAG.
   (b) FOR EACH ADDITIONAL VERTICAL POINTER (OR EQUIVALENT LOAD SUCH AS A ZERO READER) REMOVE ONE OF THE "A" RESISTORS.
   (c) FOR EACH ADDITIONAL FLAG LOAD REMOVE ONE OF THE "B" RESISTORS.



19802B

Figure 6–7. ARC Type E-17 Rack, Schematic Diagram

SYMBOL IDENTIFICATION TABLE		
SYMBOL NO.	DRAWING NO.	DESCRIPTION
C401	16143	1000 uf
C402	16143	1000 uf
C403	16143	1000 uf
J401	12095	RECEPTACLE
J402	12095	RECEPTACLE
J403	12095	RECEPTACLE
J404	12097	RECEPTACLE (KEY C)
J405	12425	RECEPTACLE (KEY C)
J406	12348	RECEPTACLE (KEY R)
K401	14484	14V RELAY
	14485	28V RELAY
R401	201	1000 OHMS
R402	201	1000 OHMS
R403	201	1000 OHMS
R404	201	1000 OHMS
Z401	16798	FILTER

NOTES:

1. FOR SCHEMATIC DIAGRAM SEE FIGURE 6-7.
2. ALL COLORED WIRES MARKED "NO. 18" ARE NO. 18 STRANDED COPPER, VINYLITE INSULATE
3. ALL OTHER CCLORED WIRES ARE NO. 22 SOLID COPPER.
4. ALL UNMARKED WIRES ARE NO. 22 TINNED SOLI COPPER, VINYLITE INSULATED.
5. INSTALLATION OF RESISTORS:
   (a) WITH SHUNT RESISTORS R401, R402, R403, AND R404 AS SHOWN, THE SYSTEM IS ADJUSTED TO FEED ONE VERTICAL POINTER AND ONE FLAG.
   (b) FOR EACH ADDITIONAL VERTICAL POINTE (OR EQUIVALENT LOAD SUCH AS ZERO READER) REMOVE ONE RESISTOR, EITHER R401 OR R402.
   (c) FOR EACH ADDITIONAL FLAG LOAD REMOV ONE RESISTOR, EITHER R403 OR R404.

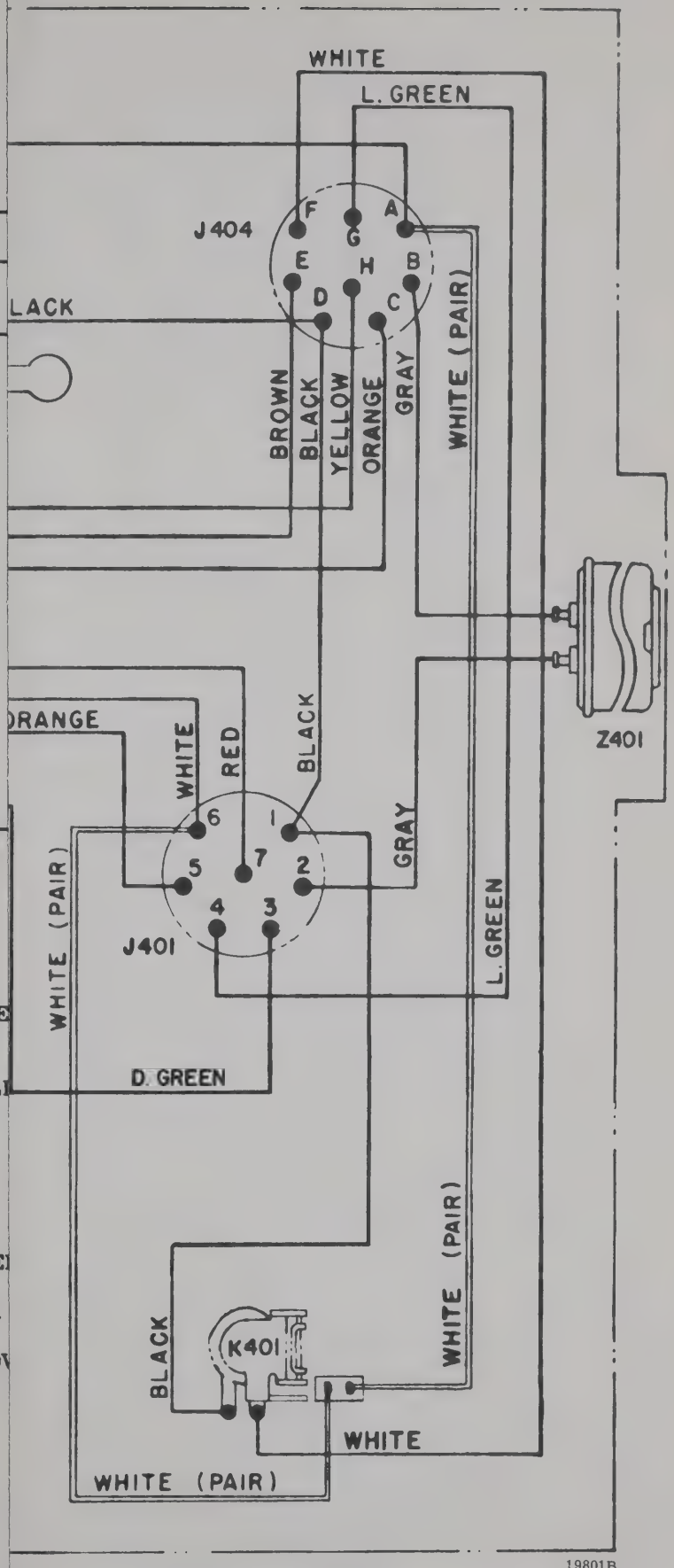


Figure 6–8. ARC Type E-17 Rack, Wiring Diagram

SYMBOL IDENTIFICATION TABLE		
SYMBOL NO.	DRAWING NO.	DESCRIPTION
C401	16143	1000 uf
C402	16143	1000 uf
C403	16143	1000 uf
J401	12095	RECEPTACLE
J402	12095	RECEPTACLE
J403	12095	RECEPTACLE
J404	12097	RECEPTACLE (KEY C)
J405	12425	RECEPTACLE (KEY C)
J406	12348	RECEPTACLE (KEY R)
K401	14484 14485	14V RELAY 28V RELAY
R401	201	1000 OHMS
R402	201	1000 OHMS
R403	201	1000 OHMS
R404	201	1000 OHMS
Z401	16798	FILTER

NOTES:

1. FOR SCHEMATIC DIAGRAM SEE FIGURE 6-7.
2. ALL COLORED WIRES MARKED "NO. 18" ARE NO. 18 STRANDED COPPER, VINYLITE INSULATED.
3. ALL OTHER CCLORED WIRES ARE NO. 22 SOLID COPPER.
4. ALL UNMARKED WIRES ARE NO. 22 TINNED SOLID COPPER, VINYLITE INSULATED.
5. INSTALLATION OF RESISTORS:
   (a) WITH SHUNT RESISTORS R401, R402, R403, AND R404 AS SHOWN, THE SYSTEM IS ADJUSTED TO FEED ONE VERTICAL POINTER AND ONE FLAG.
   (b) FOR EACH ADDITIONAL VERTICAL POINTER (OR EQUIVALENT LOAD SUCH AS ZERO READER) REMOVE ONE RESISTOR, EITHER R401 OR R402.
   (c) FOR EACH ADDITIONAL FLAG LOAD REMOVE ONE RESISTOR, EITHER R403 OR R404.

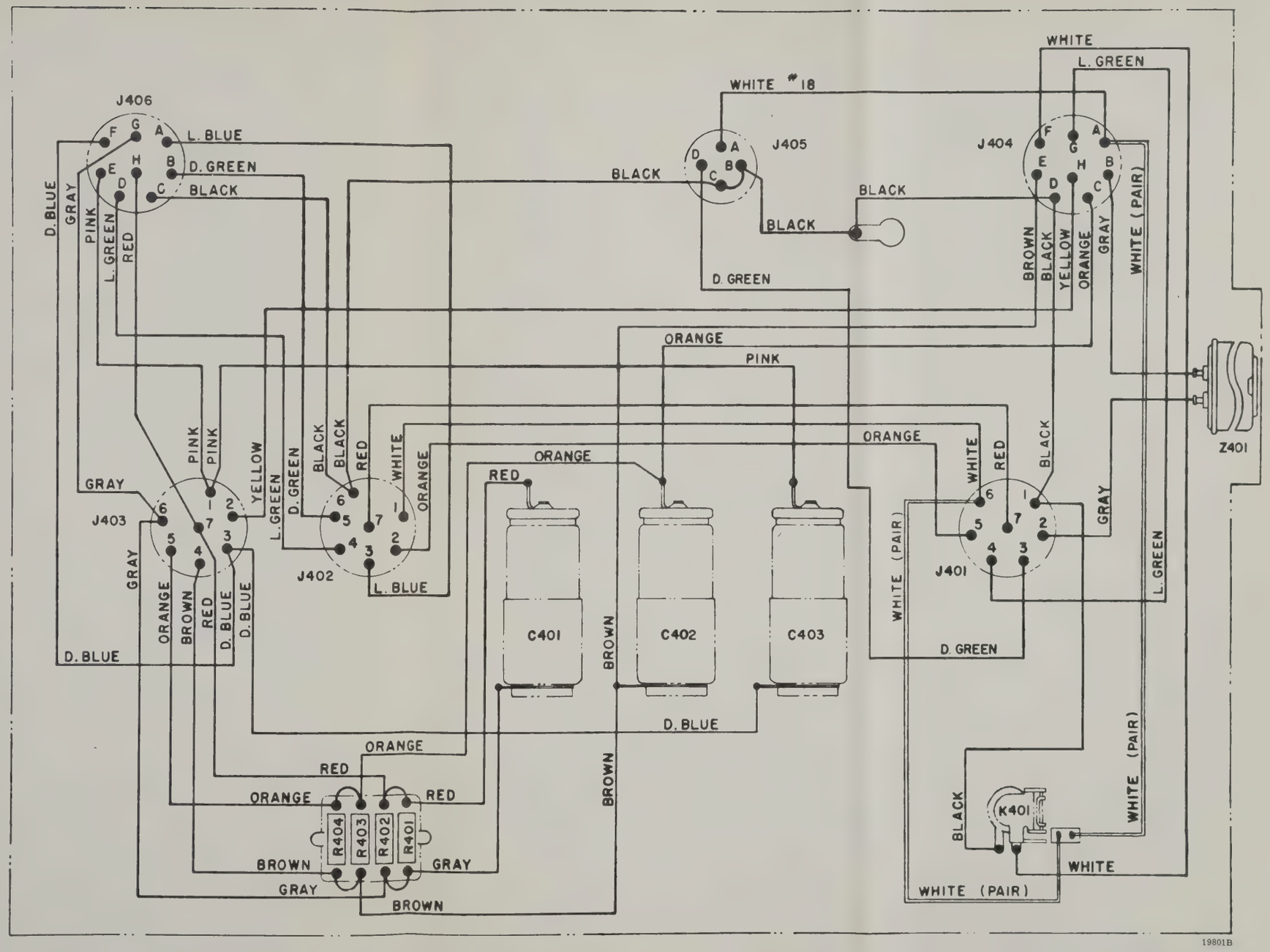
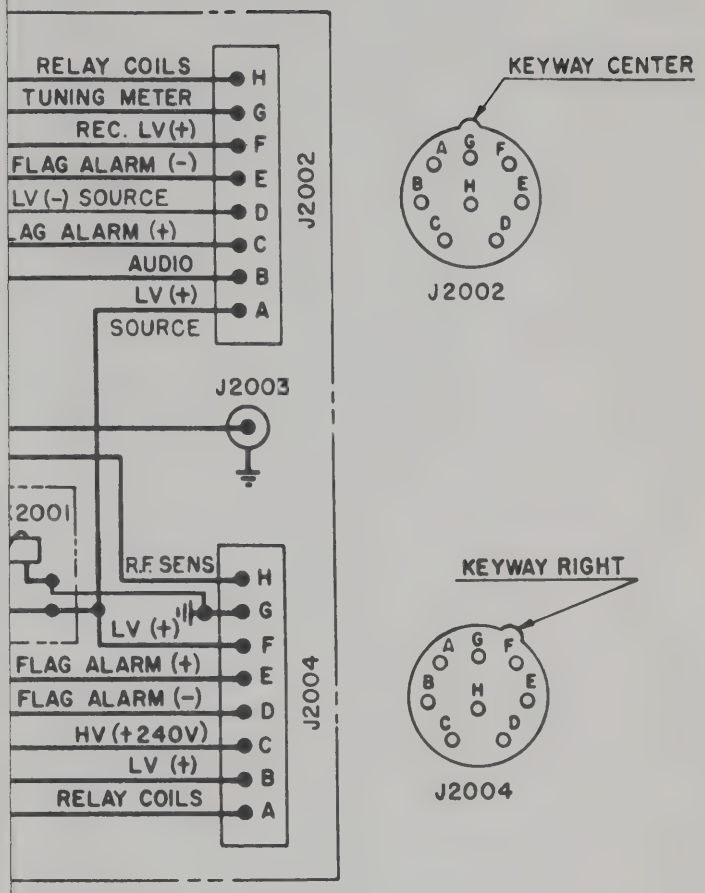


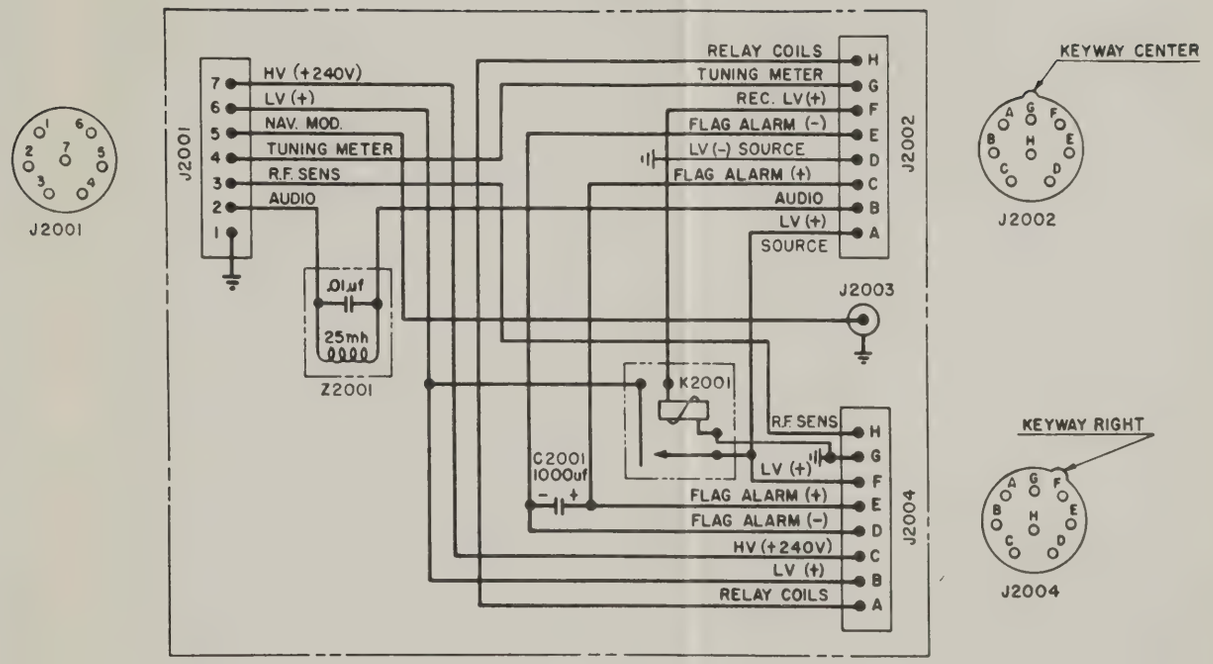
Figure 6–8. ARC Type E-17 Rack, Wiring Diagram



URE 6-10.
ZED POSITION.
OM WIRED SIDE

21192A

Figure 6–9. ARC Type E-18 Rack, Schematic Diagram



NOTES:

1. FOR WIRING DIAGRAM SEE FIGURE 6-10.
2. RELAY IS SHOWN IN UNENERGIZED POSITION.
3. CONNECTIONS ARE SHOWN FROM WIRED SIDE OF CONNECTORS.

21192A

Figure 6–9. ARC Type E-18 Rack, Schematic Diagram

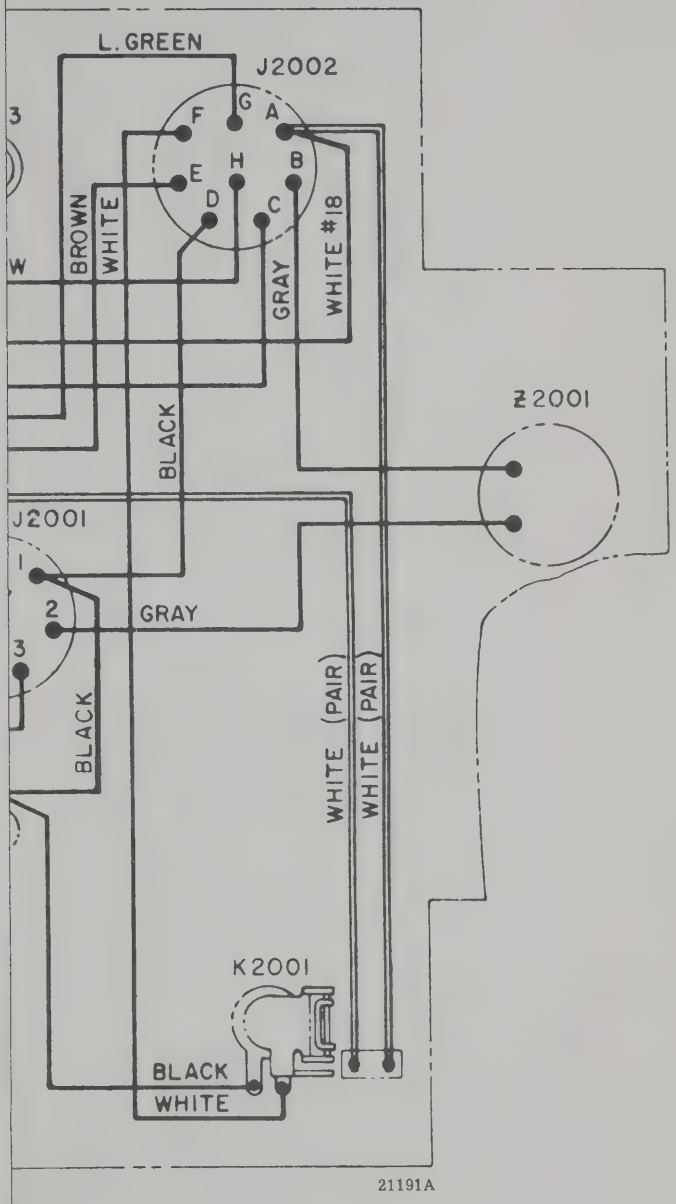


Figure 6–10. ARC Type E-18 Rack, Wiring Diagram

SYMBOL IDENTIFICATION TABLE		
SYMBOL NO.	DRAWING NO.	DESCRIPTION
C2001	16143	1000 uf
J2001	12095	RECEPTACLE
J2002	12097	RECEPTACLE (KEYC)
J2003	15185	RECEPTACLE
J2004	12348	RECEPTACLE (KEYR)
K2001	14484	14V RELAY
	14485	28V RELAY
Z2001	16798	FILTER, AUDIO

NOTES:

1. FOR SCHEMATIC DIAGRAM SEE FIGURE 6-9.
2. ALL WIRES ARE NO. 22 SOLID COPPER UNLESS OTHERWISE SPECIFIED.
3. CONNECTIONS ARE SHOWN FROM WIRED SIDE OF CONNECTORS.

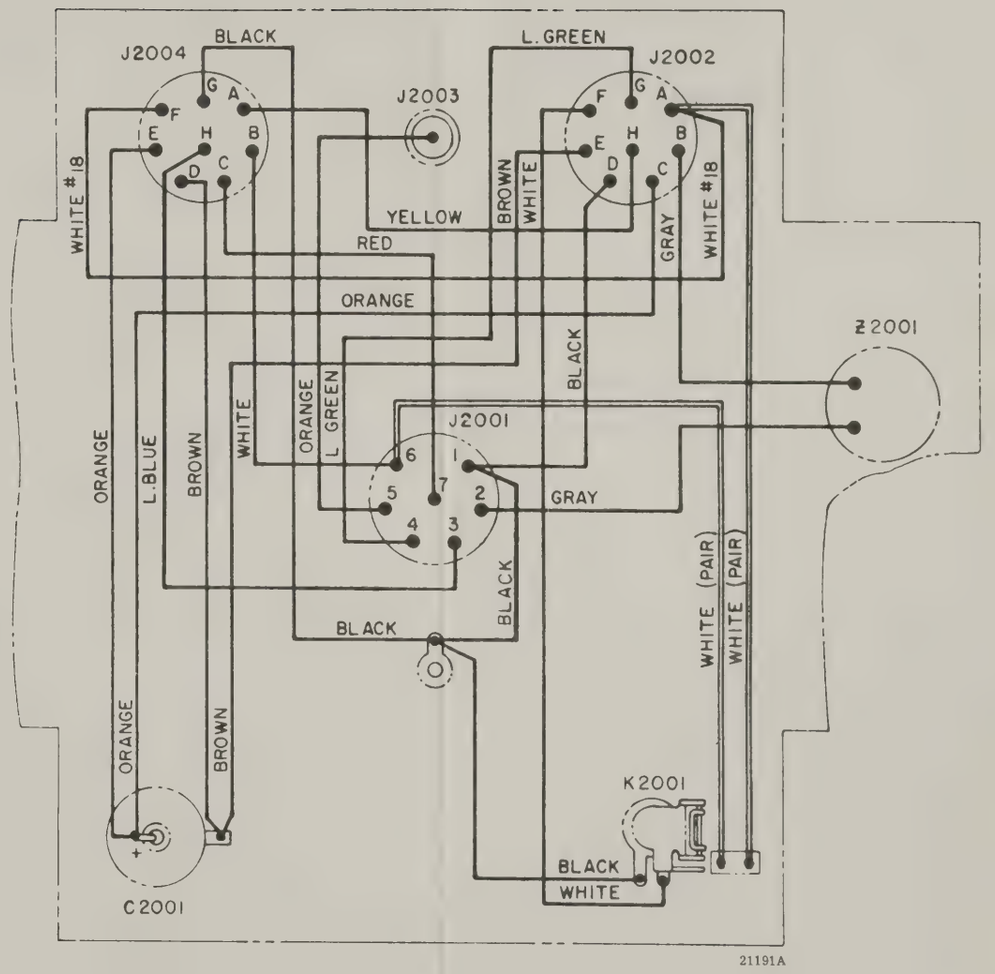


Figure 6–10. ARC Type E-18 Rack, Wiring Diagram

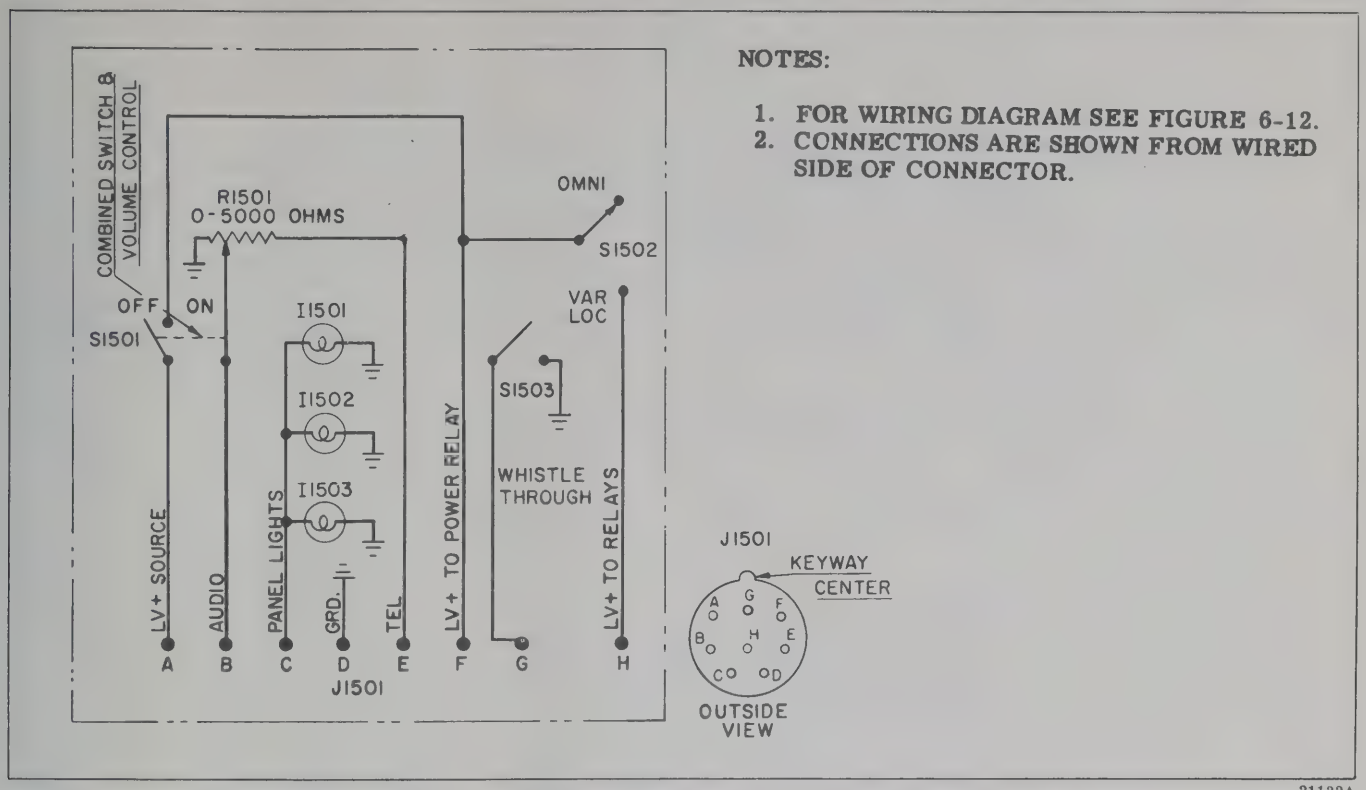


Figure 6–11. ARC Type C-1254A Control Unit, Schematic Diagram

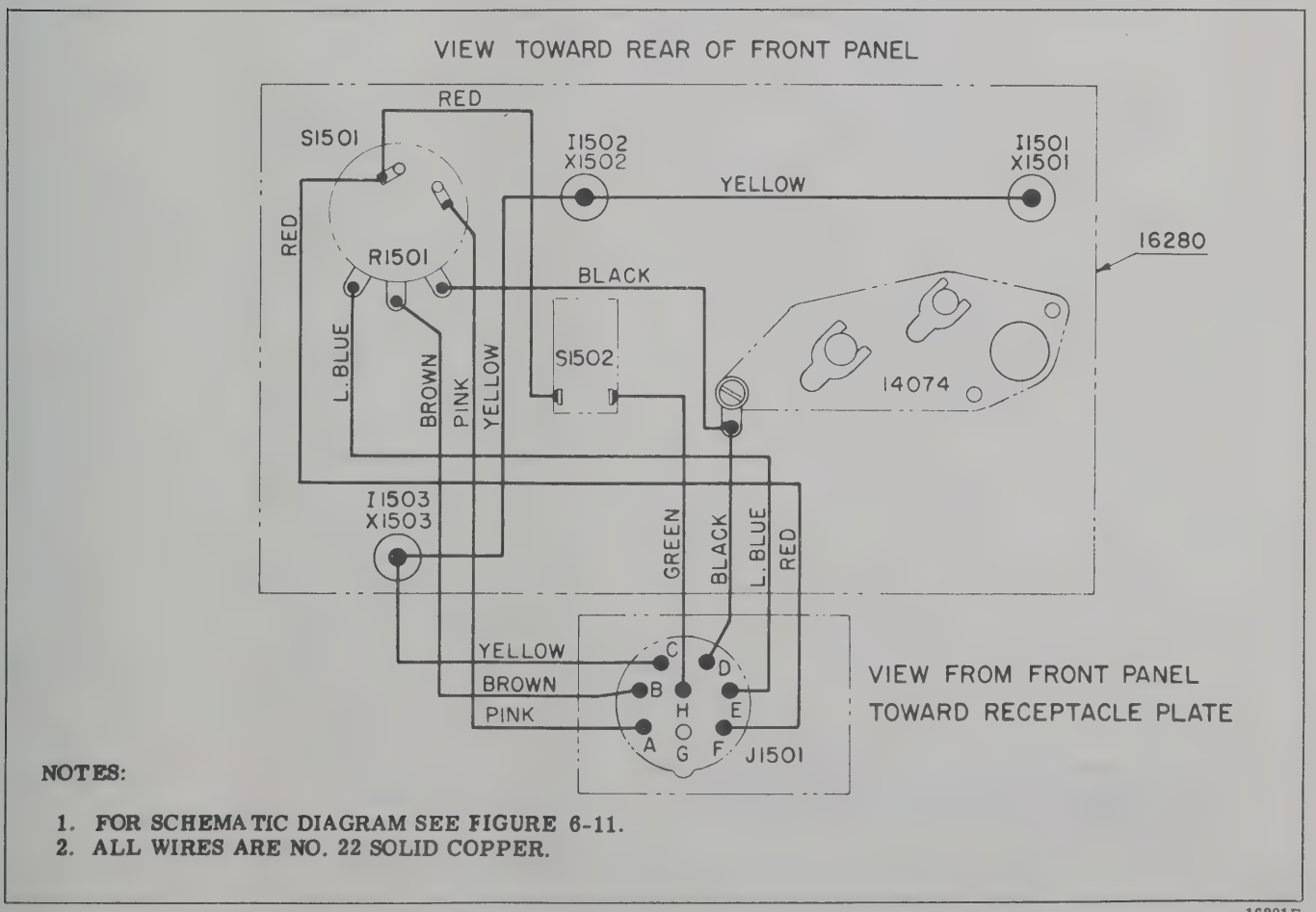
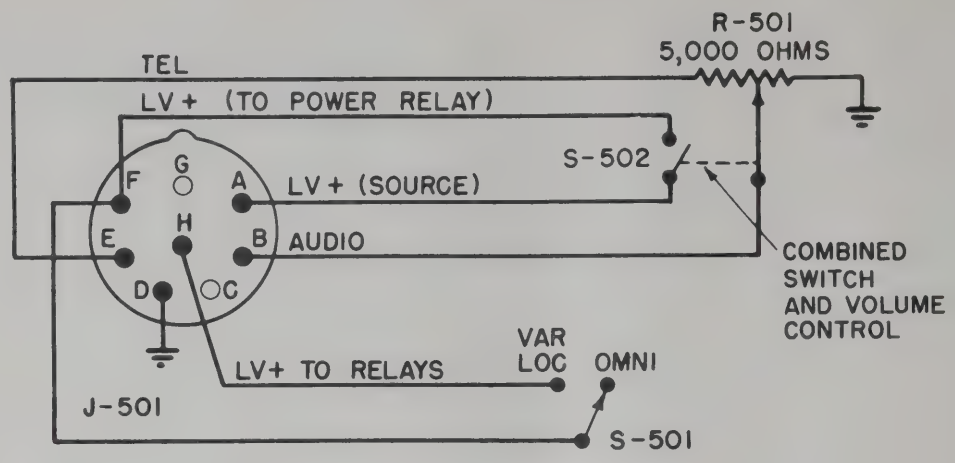


Figure 6–12. ARC Type C-1254A Control Unit, Wiring Diagram

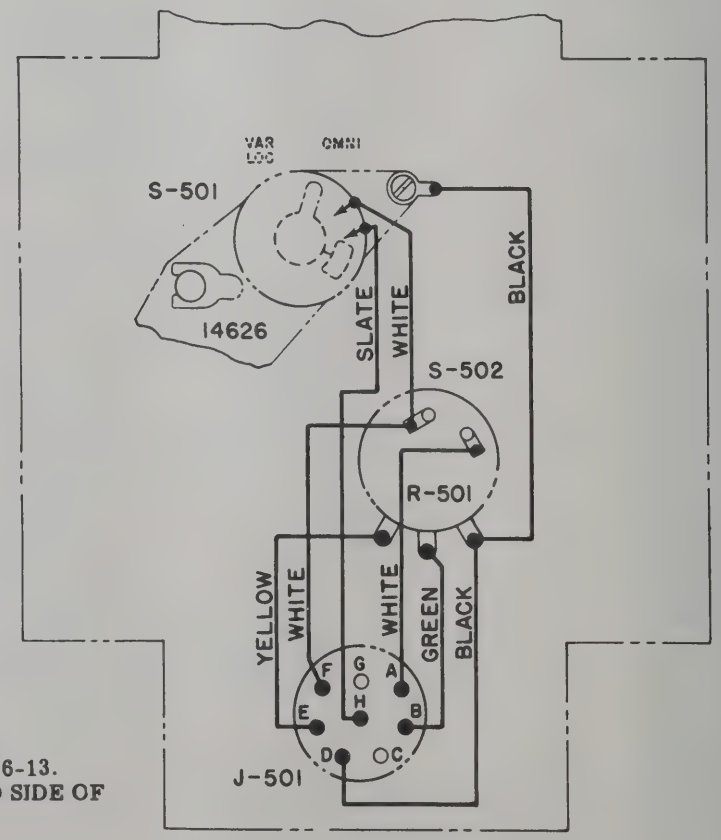


NOTES:

1. FOR WIRING DIAGRAM SEE FIGURE 6-14.
2. CONNECTIONS ARE SHOWN FROM WIRED SIDE OF CONNECTOR.

15603A

Figure 6–13. ARC Type C-22A Control Unit, Schematic Diagram

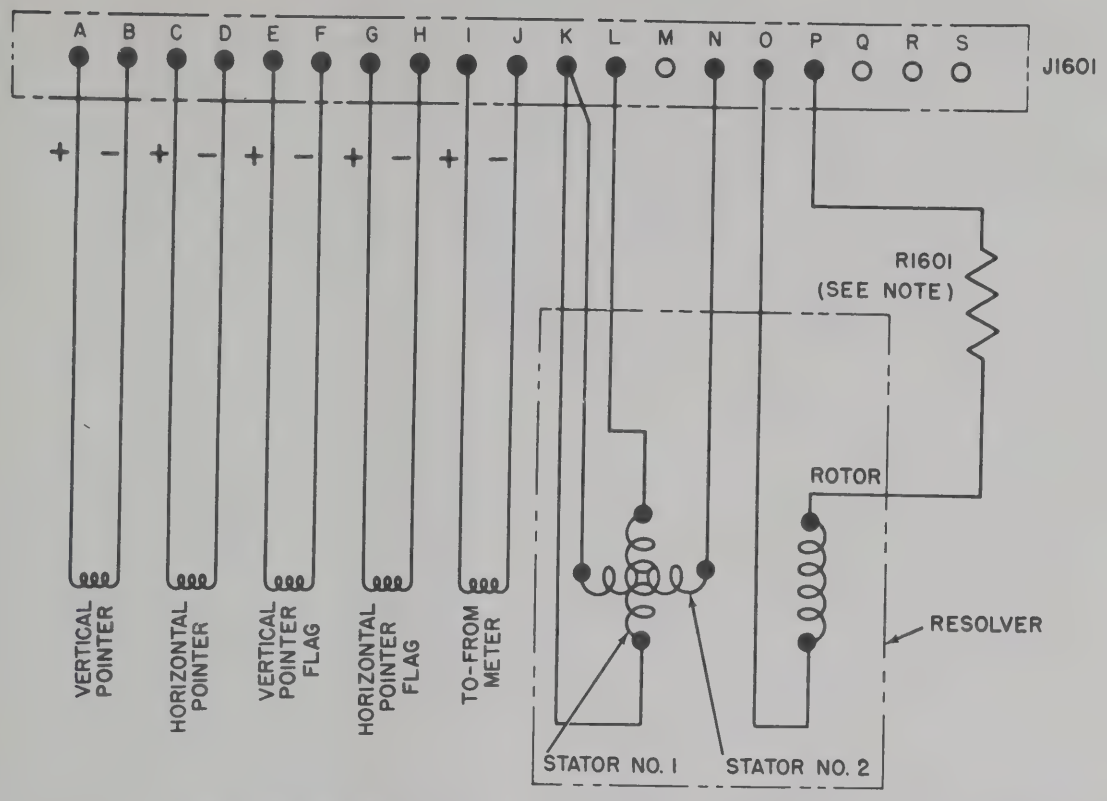


NOTES:

1. ALL WIRES ARE NO. 22 SOLID COPPER.
2. FOR SCHEMATIC DIAGRAM SEE FIGURE 6-13.
3. CONNECTIONS ARE SHOWN FROM WIRED SIDE OF CONNECTOR.

15602B

Figure 6–14. ARC Type C-22A Control Unit, Wiring Diagram



MECHANISM	RECEPTACLE PINS +	RECEPTACLE PINS -	DEFLECTION	SENSITIVITY MICROAMPERES	RESISTANCE OHMS
VERTICAL POINTER	A	B	RIGHT	150-0-150 ±7.5	1000 ±30
HORIZONTAL POINTER	C	D	DOWN	150-0-150 ±7.5	1000 ±30
VERTICAL POINTER FLAG	E	F	DOWN	125 ±6.25 SUPPRESSED 250 ±12.5 CONCEALED	1000 ±30
HORIZONTAL POINTER FLAG	G	H	RIGHT	125 ±6.25 SUPPRESSED 250 ±12.5 CONCEALED	1000 ±30
TO-FROM METER	I	J	TO	90-0-90 ±15	335 ±67

RESOLVER SYNCHRO	RECEPTACLE PINS		RESISTANCE OHMS
STATOR NO. 1	GREEN YELLOW	K L	1040 ±125
STATOR NO. 2	GREY BLACK	K N	1040 ±125
ROTOR CIRCUIT	RED WHITE	O P	2775 ±425

NOTE:

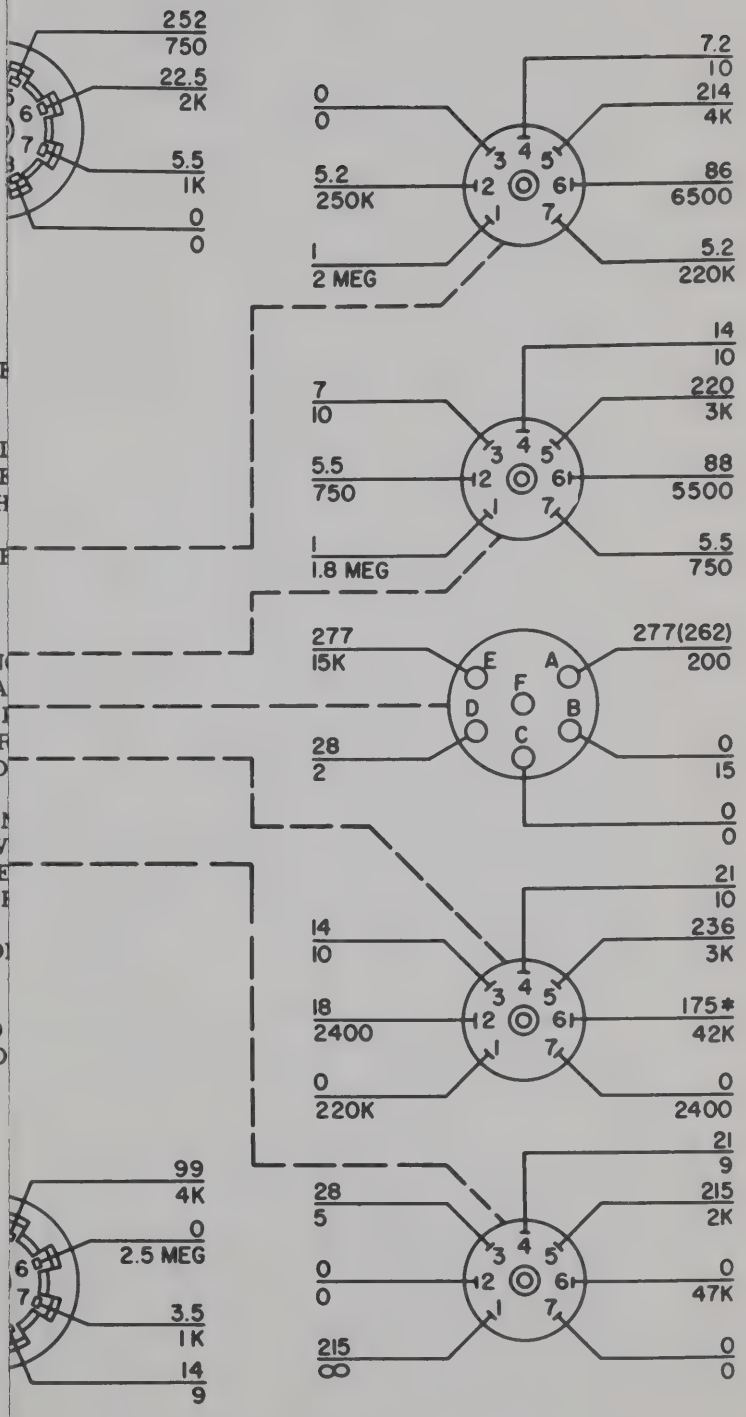
VALUE DETERMINED AT TIME OF ASSEMBLY.

16706K

Figure 6–15. ARC Type IN-10 Course Indicator, Schematic Diagram

NOTES:

1. VIEW IS BOTTOM OF CHASSIS. ALL RE
   SEEN FROM WIRED SIDE.
2. ALL VOLTAGES ARE DC AND APPEAR
3. ALL RESISTANCES IN OHMS, (MULTIPI
   AND APPEAR BELOW THE REFERENCE
4. ALL MEASUREMENTS ARE MADE WITH
   APPROXIMATE (TOLERANCE ± 10%).
5. ALL DC VOLTAGES TAKEN UNDER THE
   a. DYNAMOTOR D-10A CONNECTED.
   b. VOLTAGE AT TERMINAL A OF J101
      VOLTAGE OF 28 VOLTS DC.
   c. TERMINAL 3 OF J103 GROUNDED: N
   d. VOLTMETER SCALE: 500-VOLT SCA
      50 VOLTS; 50-VOLT SCALE FOR VO
   e. MEASUREMENTS APPLY TO EITHER
      1000 OHMS-PER-VOLT, UNLESS IND
      PER-VOLT ONLY.
   f. WIRED PLUG ARC-11934 (P101) CON
6. RESISTANCE MEASUREMENTS MADE W
   RECEIVER DISCONNECTED FROM OTHE
7. MULTIMETER SIMPSON MODEL 260, O
   MEASUREMENTS.
8. VOLTAGE IN PARENTHESES IS THAT O
   SUPPLIES 130 MA TO A TRANSMITTER
   DRAIN.
9. VOLTAGES SHOWN WILL BE LOWERED
   DYNAMOTOR SUPPLIES 14 MA TO A CO
   NORMAL RECEIVER DRAIN OF 70 MA.

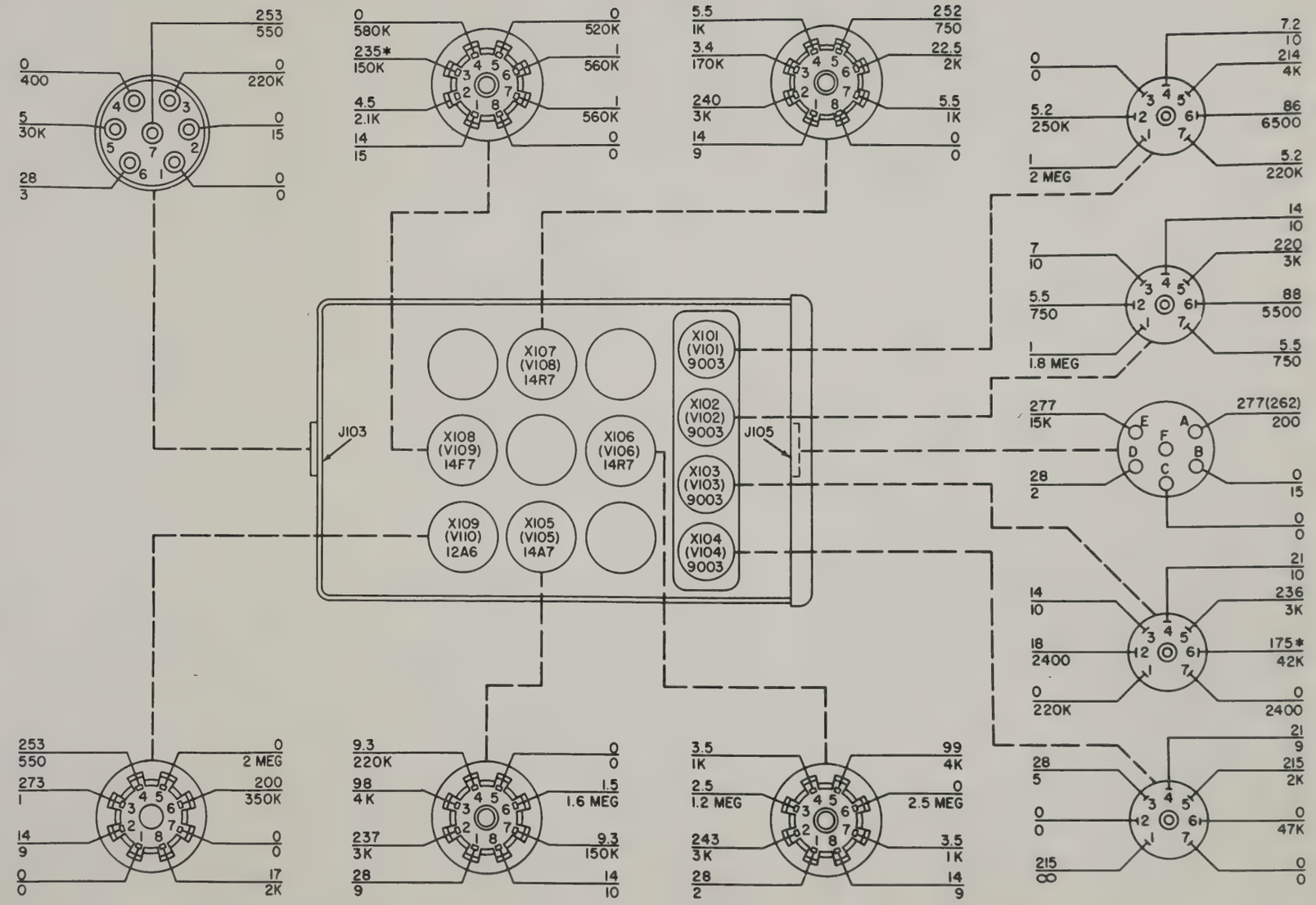


TP1379

Figure 6–16. ARC Type R-32 Receiver, Voltage and Resistance Diagram

NOTES:

1. VIEW IS BOTTOM OF CHASSIS. ALL RECEPTACLES SHOWN AS SEEN FROM WIRED SIDE.
2. ALL VOLTAGES ARE DC AND APPEAR ABOVE THE REFERENCE LINE.
3. ALL RESISTANCES IN OHMS, (MULTIPLIERS: K=1000; MEG=1, 000, 000) AND APPEAR BELOW THE REFERENCE LINE.
4. ALL MEASUREMENTS ARE MADE WITH RESPECT TO GROUND AND ARE APPROXIMATE (TOLERANCE ± 10%).
5. ALL DC VOLTAGES TAKEN UNDER THE FOLLOWING CONDITIONS:
   a. DYNAMOTOR D-10A CONNECTED.
   b. VOLTAGE AT TERMINAL A OF J101 SET AT NOMINAL SUPPLY VOLTAGE OF 28 VOLTS DC.
   c. TERMINAL 3 OF J103 GROUNDED: NO SIGNAL INPUT.
   d. VOLTMETER SCALE: 500-VOLT SCALE FOR VOLTAGES ABOVE 50 VOLTS; 50-VOLT SCALE FOR VOLTAGES BELOW 50 VOLTS.
   e. MEASUREMENTS APPLY TO EITHER 20,000 OHMS-PER-VOLT OR 1000 OHMS-PER-VOLT, UNLESS INDICATED BY * FOR 20,000 OHMS-PER-VOLT ONLY.
   f. WIRED PLUG ARC-11934 (P101) CONNECTED TO J105.
6. RESISTANCE MEASUREMENTS MADE WITH DYNAMOTOR IN PLACE BUT RECEIVER DISCONNECTED FROM OTHER COMPONENTS.
7. MULTIMETER SIMPSON MODEL 260, OR EQUIVALENT, USED FOR ALL MEASUREMENTS.
8. VOLTAGE IN PARENTHESES IS THAT OBTAINED WHEN DYNAMOTOR SUPPLIES 130 MA TO A TRANSMITTER CONNECTED TO J105; NO RECEIVER DRAIN.
9. VOLTAGES SHOWN WILL BE LOWERED APPROXIMATELY 5% WHEN DYNAMOTOR SUPPLIES 14 MA TO A CONVERTER IN ADDITION TO THE NORMAL RECEIVER DRAIN OF 70 MA.

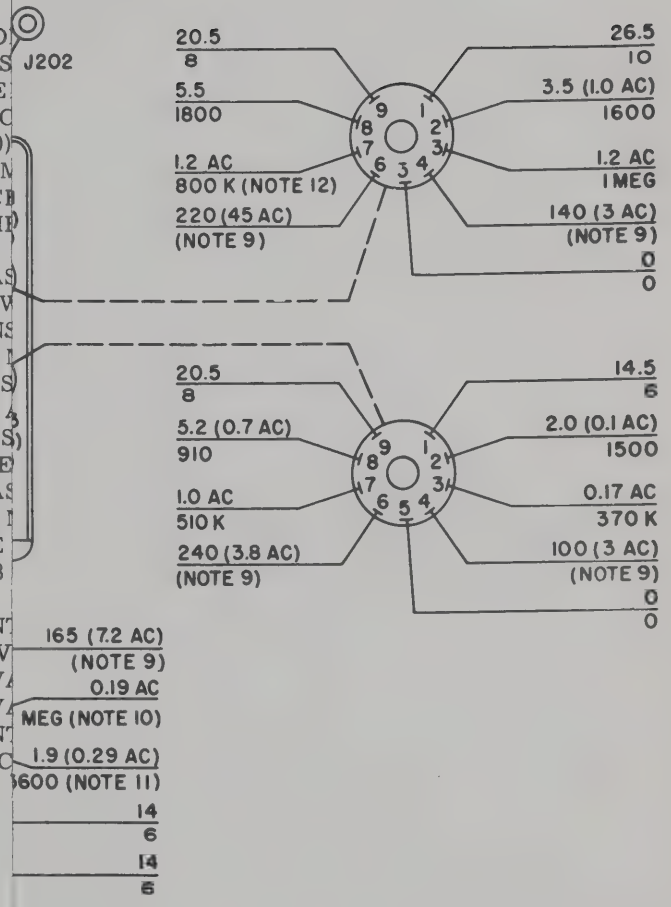


TP1379

Figure 6–16. ARC Type R-32 Receiver, Voltage and Resistance Diagram

NOTES:

1. VIEW IS BOTTO
2. ALL VOLTAGES J202
   ABOVE THE RE
3. ALL RESISTANC
   MEG=1, 000, 000)
4. ALL MEASUREM
   AND J203 WHICH
5. RESISTANCE MI
   SYSTEM.
6. VOLTAGE MEAS
   SYSTEM, AND V
   TYPE D-10A INS
7. D-C VOLTAGE
   VOLTMETER, S
   WITH LV+ SET
   ALL VOLTAGES
   FOR 28-VOLT E
   VOLTAGE MEAS
8. A-C VOLTAGE
   VACUUM TUBE
   LEVELS OF 1.8
   AT 9960 CPS.
9. NO SIGNIFICANT
10. DEPENDS ON V
11. DEPENDS ON VA
12. DEPENDS ON VA
13. NO SIGNIFICANT
    RELAY K201 AC

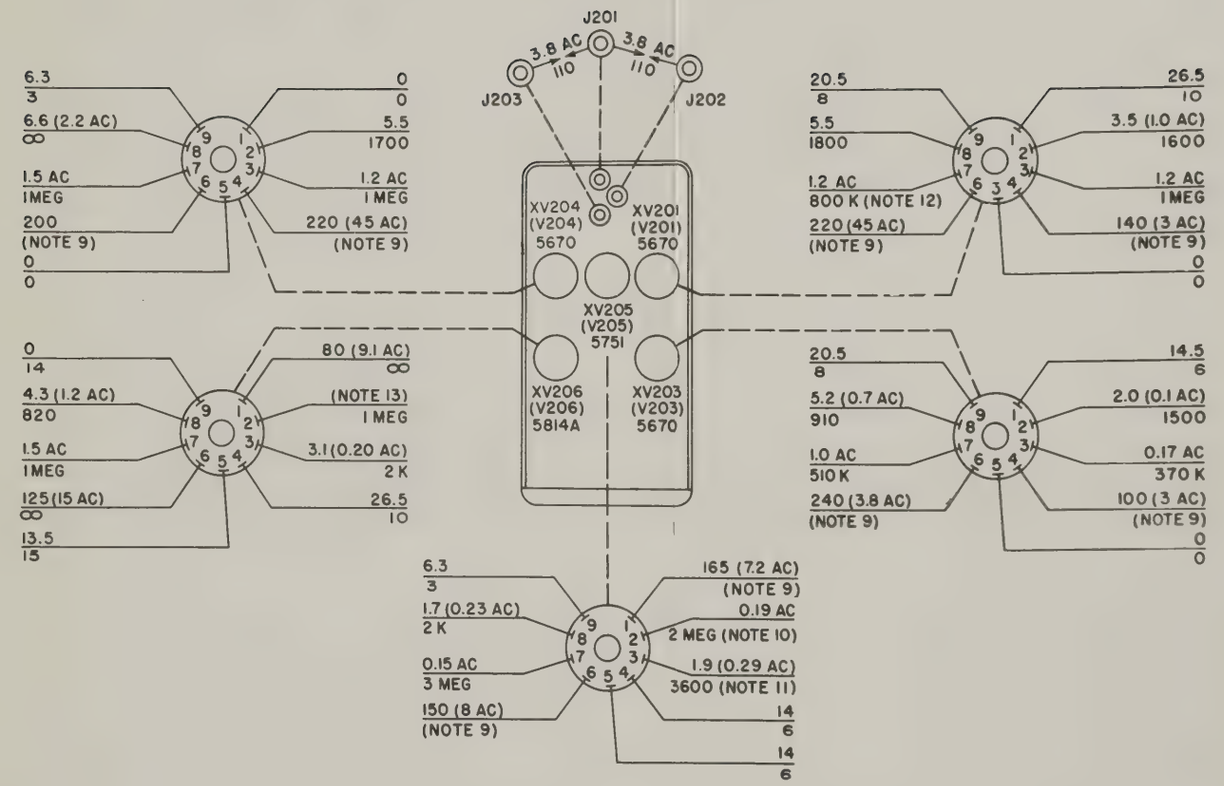


TP1381A

Figure 6–17. ARC Type B-13A Converter, Voltage and Resistance Diagram

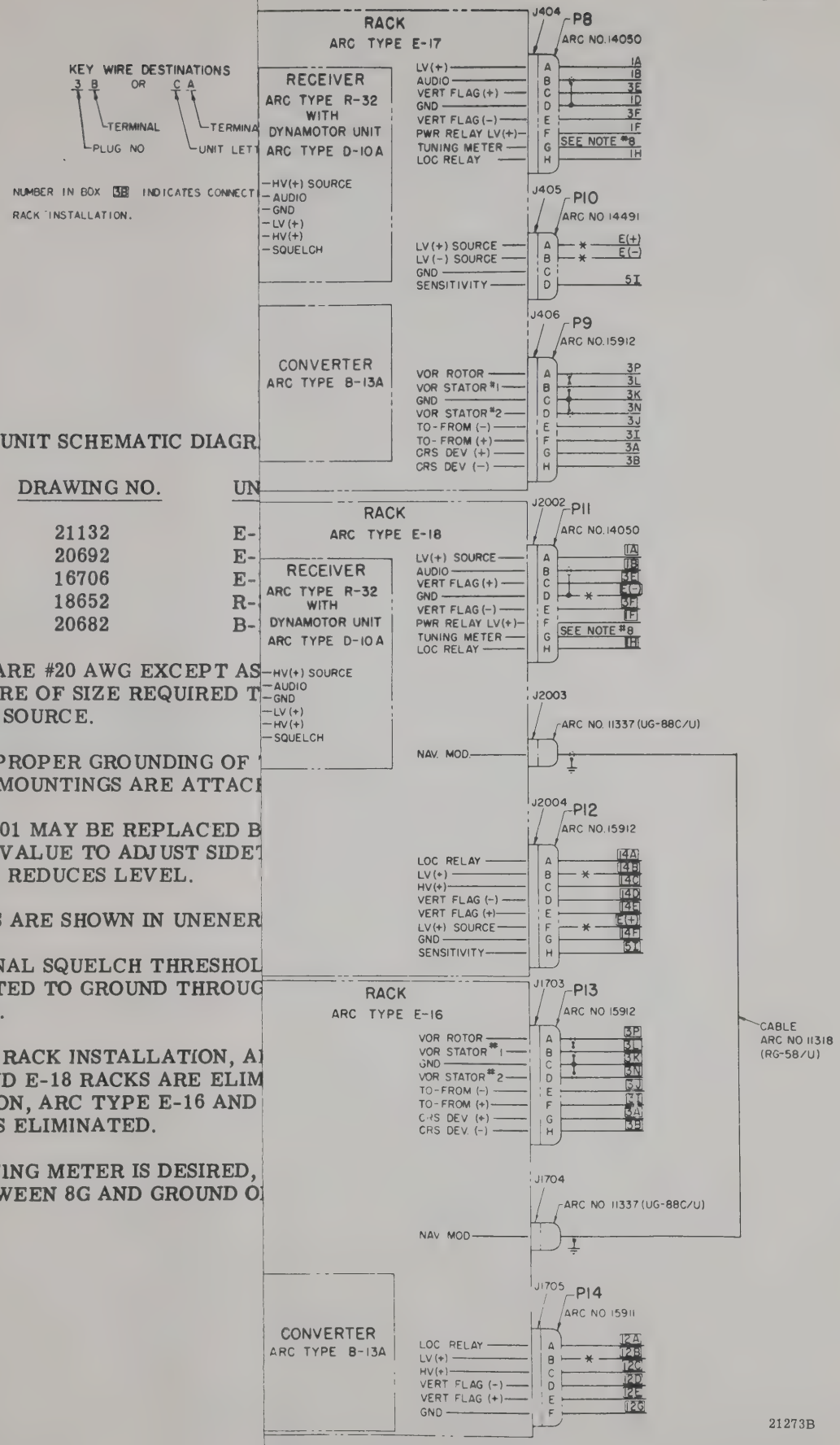
NOTES:

1. VIEW IS BOTTOM OF CHASSIS.
2. ALL VOLTAGES ARE DC, UNLESS OTHERWISE NOTED, AND APPEAR ABOVE THE REFERENCE LINE.
3. ALL RESISTANCE VALUES ARE IN OHMS (MULTIPLIERS: K=1000; MEG=1,000,000) AND APPEAR BELOW THE REFERENCE LINE.
4. ALL MEASUREMENTS MADE WITH RESPECT TO GROUND EXCEPT J201 AND J203 WHICH ARE MADE WITH RESPECT TO J202.
5. RESISTANCE MEASUREMENTS MADE WITH B-13A DISCONNECTED FROM SYSTEM.
6. VOLTAGE MEASUREMENTS MADE WITH B-13A CONNECTED IN SYSTEM, AND WITH HIGH VOLTAGE SUPPLIED BY DYNAMOTOR ARC TYPE D-10A INSTALLED ON RECEIVER.
7. D-C VOLTAGE MEASUREMENTS MADE WITH 20,000 OHMS-PER-VOLT VOLTMETER, SUCH AS SIMPSON MODEL 260 OR WESTON MODEL 790, WITH LV+ SET AT THE NOMINAL SUPPLY VOLTAGE OF 14 OR 28 VOLTS. ALL VOLTAGES ARE APPROXIMATE AND WILL BE A LITTLE HIGHER FOR 28-VOLT EQUIPMENT THAN FOR 14-VOLT EQUIPMENT. FILAMENT VOLTAGE MEASUREMENTS MADE WITH 28-VOLT LV+ SUPPLY.
8. A-C VOLTAGE MEASUREMENTS MADE WITH BALLANTINE MODEL 300 VACUUM TUBE VOLTMETER, AND WITH "STANDARD" TEST SIGNAL LEVELS OF 1.8 VOLTS (±0.1 VOLT) AT 30 CPS, AND 1.8 VOLTS (±0.2 VOLT) AT 9960 CPS.
9. NO SIGNIFICANT MEASUREMENT DUE TO CAPACITOR CHARGING.
10. DEPENDS ON VALUE OF R222 AND SETTING OF R225.
11. DEPENDS ON VALUE (SETTING) OF R226.
12. DEPENDS ON VALUE (SETTING) OF R250.
13. NO SIGNIFICANT MEASUREMENT. 1.8 AC ON INPUT SIDE OF C236 WITH RELAY K201 ACTUATED.



TP1381A

Figure 6–17. ARC Type B-13A Converter, Voltage and Resistance Diagram



NOTES:

1. INDIVIDUAL UNIT SCHEMATIC DIAGR

UNIT	DRAWING NO.	UN
C-1254A	21132	E-
C-76A	20692	E-
IN-10	16706	E-
T-20	18652	R-
T-22	20682	B-

2. ALL WIRES ARE #20 AWG EXCEPT AS MARKED * ARE OF SIZE REQUIRED T DROP FROM SOURCE.

3. TO ASSURE PROPER GROUNDING OF WHICH ALL MOUNTINGS ARE ATTAC

4. RESISTOR #201 MAY BE REPLACED B DIFFERENT VALUE TO ADJUST SIDE RESISTANCE REDUCES LEVEL.

5. ALL RELAYS ARE SHOWN IN UNENER

6. FOR EXTERNAL SQUELCH THRESHOL BE CONNECTED TO GROUND THROUG RESISTANCE.

7. FOR SINGLE RACK INSTALLATION, A AND E-16 AND E-18 RACKS ARE ELIM INSTALLATION, ARC TYPE E-16 AND E-17 RACK IS ELIMINATED.

8. IF OMNI TUNING METER IS DESIRED, METER BETWEEN 8G AND GROUND O

gure 6–18. ARC Type 15E Equipment with ARC Type T-20 Transmitter, System Schematic Diagram

KEY WIRE DESTINATIONS

3 B OR C A

TERMINAL — PLUG NO — TERMINAL — UNIT LETTER

NUMBER IN BOX 3B INDICATES CONNECTION FOR OPTIONAL DUAL RACK INSTALLATION.

NOTES:

1. INDIVIDUAL UNIT SCHEMATIC DIAGRAMS ARE AS FOLLOWS:

UNIT	DRAWING NO.	UNIT	DRAWING NO.
C-1254A	21132	E-16	16772
C-76A	20692	E-17	19802
IN-10	16706	E-18	21192
T-20	18652	R-32	19812
T-22	20682	B-13A	16832

2. ALL WIRES ARE #20 AWG EXCEPT AS OTHERWISE NOTED . WIRES MARKED * ARE OF SIZE REQUIRED TO PRODUCE LESS THAN 0.5V DROP FROM SOURCE.

3. TO ASSURE PROPER GROUNDING OF THE SYSTEM, SURFACES TO WHICH ALL MOUNTINGS ARE ATTACHED MUST BE CLEAN METAL.

4. RESISTOR #201 MAY BE REPLACED BY A 1/2 WATT RESISTOR OF DIFFERENT VALUE TO ADJUST SIDETONE LEVEL. INCREASED RESISTANCE REDUCES LEVEL.

5. ALL RELAYS ARE SHOWN IN UNENERGIZED POSITION.

6. FOR EXTERNAL SQUELCH THRESHOLD CONTROL, 6F OR 7F MAY BE CONNECTED TO GROUND THROUGH A 0-100K VARIABLE RESISTANCE.

7. FOR SINGLE RACK INSTALLATION, ARC TYPE E-17 RACK IS USED AND E-16 AND E-18 RACKS ARE ELIMINATED. FOR DUAL RACK INSTALLATION, ARC TYPE E-16 AND E-18 RACKS ARE USED, AND E-17 RACK IS ELIMINATED.

8. IF OMNI TUNING METER IS DESIRED, CONNECT 0-1 MA MOVEMENT METER BETWEEN 8G AND GROUND OR 11G AND GROUND.

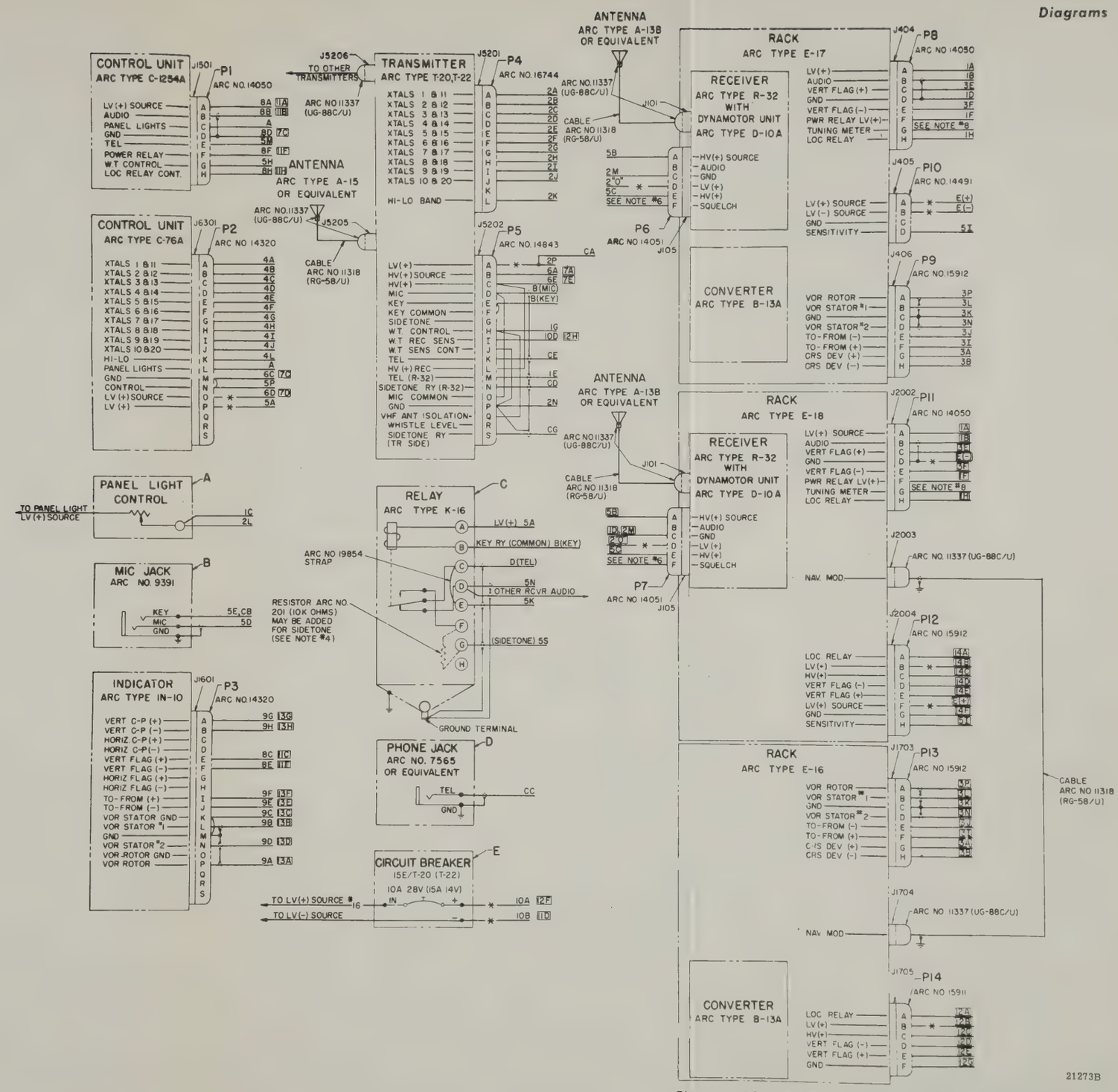


Figure 6–18. ARC Type 15E Equipment with ARC Type T-20 Transmitter, System Schematic Diagram

ARC TYPE B-13A-1 CONVERTER

Supplement to Instruction Book for
ARC Type 15E VHF Navigation Equipment

SECTION I

GENERAL INFORMATION

1-1. INTRODUCTION.

This supplement describes the differences between the ARC Type B-13A and the ARC Type B-13A-1 Converters. The B-13A, which is a unit of the ARC Type 15D and 15E VHF Navigation Receiving Equipments, may be replaced by the B-13A-1 without any external physical or electrical alterations since only the internal circuit is changed. A VOR flag-emphasizer circuit, and VOR and localizer flag sensitivity controls are included in the B-13A-1. These features have been added to permit the use of the B-13A-1 with the ARC Type R-13B, R-32, or R-34A Receiver.

The information pertaining to the B-13A Converter included in the instruction books for the ARC Type 15D and 15E VHF Navigation Equipment (ARC Publication No. 7010027 and 7010067, respectively) is applicable to the B-13A-1 Converter, except as described in this supplement.

1-2. DESCRIPTION.

The B-13A-1 Converter (Figures 1 and 2) is a six-tube unit designed to accept VOR and localizer signals delivered by the R-13B, R-32 or R-34A Receiver. It converts these signals to a form that is presented visually by a cross-pointer meter similar to that included in the ARC Type IN-10 or IN-14 Course Indicator. The unit has no operating controls, and receives all operating voltages from the associated VOR receiver and the external low-voltage power source. Input and output connectors are located at the rear of the chassis and mate with connectors on the ARC Type E-14, E-16, or E-17 Rack. All electron tubes are accessible with the removal of the top cover. Five alignment controls are located on the front panel. These controls are not required for any operating procedure and are set and locked during the alignment of the B-13A-1.

1-3. SPECIFICATIONS.

The specifications for the B-13A-1 Converter are identical to those listed for the B-13A Converter except for the following:

Weight:	6.1 pounds
Environmental Limit:	Meets FAA TSO C-36 and C-40

TP1318

Figure 1. ARC Type B-13A-1 Converter

SECTION II

PRINCIPLES OF OPERATION

2-1. GENERAL.

Information contained in the instruction books for Type 15D and 15E Equipments which pertains to the principles of operation of the B-13A Converter is applicable to the B-13A-1 except for those portions which refer to the VOR and localizer flag control circuits. The following text and associated figures (see Figures 3 and 4) describe the principles of operation of the B-13A-1 flag circuits.

2-2. FLAG CIRCUITS.

General. The vertical pointer flag alarm is used to indicate the absence of usable output signals from the converter during both VOR and localizer operation. The flag is held out of sight by the effect of d-c current through its coil when the output of the circuits being used is reliable. When the output of the B-13A-1 becomes weak because of distance from the transmitting station, or is lost because of receiver, converter, or ground station malfunction, the current through the flag coil is reduced sufficiently to allow the flag to show.

Flag Sensitivity Controls. Two controls, LOC FLAG and VOR FLAG, are provided for adjusting the sensitivity of the course indicator's flag mechanism. The controls are adjusted for the required flag sensitivity during alignment of the B-13A-1.

Localizer Flag Control. LOC FLAG control R269 is used to adjust the sensitivity of the flag mechanism for localizer operation. The control is connected in parallel with the flag coil of the indicating instrument and acts as a variable shunt across the coil. The sum of the output voltages of filters Z202 and Z203, applied to this parallel circuit, produces a current flow through the flag coil and R269. Maximum flag sensitivity will result when R269 is set to the full clockwise position (minimum shunting). R269 is factory-adjusted so that part of the flag shows when the level of each modulating signal, 90 cps and 150 cps, is equal to 10 per cent (1/2 standard value). Crystal diode CR211 is placed in series with the flag coil to produce a nonlinear flag response, thereby ensuring a full-flag indication with the loss of one modulation.

VOR Flag Control. VOR FLAG control R268 is used to adjust the sensitivity of the flag mechanism for VOR operation. The control is connected in parallel with the flag coil of the indicating instrument and acts as a variable shunt across the coil. The sum of the outputs of reference-channel transformer T201 and variable-channel transformer T202 is applied to this parallel circuit, producing a current flow through it. Maximum flag sensitivity will result when R268 is set to the full clockwise position. R268 is factory-adjusted so that part of the flag shows when the level of both the reference and variable channel modulating signals is 15 per cent (1/2 standard value). Resistor R237 in series with R268 and the coil of the flag is used as a current-limiting device.

VOR Flag Emphasizer. The VOR flag-emphasizer circuit is designed to ensure a definite warning flag indication when either the reference-phase or variable-phase signal is unreliable. This circuit consists of a twin-triode, used essentially as two switches, the sections of which are cross-connected between the reference-channel and variable-channel output circuits. In normal operation, the variable channel signal at the plate of V201B is rectified by CR212 and the resultant d-c voltage (-25 volts) is applied to the grid of V207A to hold the tube at cutoff. At cutoff the plate impedance is essentially infinite and hence does not shunt the output of V204B. If the variable-signal output drops below a usable level, the cutoff bias will not be applied to the grid of V207A and the tube will conduct. This conduction produces a low plate impedance which heavily shunts the output of V204B. This shunting loads the output of the reference channel, attenuating it sufficiently to make the reference channel as well as the variable channel very low in output, thereby providing a definite flag indication.

By similarly connecting V207B across the output of the variable channel, and controlling its operation in the same manner as described for V207A, an unreliable reference-channel signal will cause attenuation of the variable-channel output and a definite flag showing.

SECTION III

MAINTENANCE

3-1. GENERAL.

This section provides performance tests, trouble analysis information, and alignment procedures for the B-13A-1 Converter. Information concerning test equipment, preliminary maintenance checks, and other general maintenance procedures described in the instruction books for Type 15D and 15E Equipments is applicable to both the B-13A and the B-13A-1.

3-2. PERFORMANCE TESTS AND TROUBLE ANALYSIS.

Table 3-1 outlines the procedures for checking and analyzing the performance of the B-13A-1 Converter. The tests are subtitled to identify the circuit being checked. Secondary steps marked, for example, 6A, 6B, etc., need not be performed unless an abnormal indication obtained in the basic step requires further testing to localize the trouble. Alignment procedures for the B-13A-1 are given in paragraph 3-3.

TABLE 3-1. B-13A-1 CONVERTER PERFORMANCE AND TROUBLE ANALYSIS CHECK CHART

Step	Procedure	Normal Indications	Possible Cause of Abnormal Indications
	PRELIMINARY PROCEDURE		
1	Interconnect the "standard" Type 15D or 15E, substituting the B-13A-1 under test for the "standard" B-13A-1, and the required test equipment as shown in Figure 4-3 of the Type 15D or Figure 5-3 of the Type 15E instruction books. (Unconnected test equipment shown in the applicable illustration is to be connected as and when directed in this procedure.)	None.	None.
2	Connect d-c voltmeter (30-volt range) to LV+ and G of converter test harness. Turn on primary power source. Turn control unit OFF control clockwise (on). Allow equipment to warm up for at least 15 minutes.	Meter reads 28 volts. Electron tube filaments light.	Connector J204. Defective electron tubes.
3	Connect d-c voltmeter (500-volt range) to HV+ and G test points of the converter test harness. Adjust the primary voltage input until the voltmeter reads 240 volts.	None.	None.
4	Connect Ballantine Model 300 vtvm between the NAV MOD V. and G test points of the receiver test harness. Set the receiver test harness NAV MOD SOURCE switch to EXTERNAL. Connect the	None.	None.

TABLE 3-1. B-13A-1 CONVERTER PERFORMANCE AND TROUBLE ANALYSIS CHECK CHART - Continued

Step	Procedure	Normal Indications	Possible Cause of Abnormal Indications
	PRELIMINARY PROCEDURE - Continued		
4 (cont)	DEMOD output of H-14 or H-14A Signal Generator to the EXT NAV MOD connector of the receiver test harness. Set the control unit's OMNI-VAR LOC switch to OMNI. Operate and adjust the H-14 or H-14A with "level set" indications of the r-f level and the individual 30-cycle and 9960-cycle modulations as described in the applicable instruction book. Set the signal generator's function switch to 30~ and adjust its DEMOD output to obtain a NAV MOD V. reading of 1.8 volts on the vtvm. Set the signal generator's function switch to OMNI.		
	OMNI TRACK ACCURACY CHECK		
5	Check the accuracy of the B-13A-1 for each of the 24 OMNI TRACK ANGLE TO settings of the H-14 or H-14A Signal Generator; however, proper allowance must be made for the effect of omitting receiver phase shifts from the measurements. Refer to paragraphs 4-19 through 4-21 of the Type 15D or paragraph 5-3 of the Type 15E instruction book.	IN-10 vertical needle centers for each of the ANGLE TO tracks, flag alarm is out of sight, and to-from meter indicates TO.	Connectors J204, J205. Flag circuit detail parts: CR207, CR208, R237, R238, R239, R240, R268. To-from meter circuit detail parts: CR205, CR206, R235, R236.
	Connect Ballantine Model 300 between K201 or R241 (yellow wire) and chassis ground.	Meter reads 2.3 volts.	Relay K201. Connector J204.
	Connect d-c voltmeter (500-volt range) between line terminal of K201 (red wire) or positive terminal of C219B and chassis ground. Connect meter between line terminal of K201 (red wire) and chassis ground.	Meter reads 240 volts in each case.	Connector J204. Capacitor C219B. Relay K201. Capacitors C219A, C209A, C209B, C207A, C207B, and other high-voltage circuit detail parts.
	VARIABLE CHANNEL TEST		
6	Connect Ballantine Model 300 between J202 and J203.	Meter reads between 3.8 and 4.2 volts.	Tubes V205B, V201B. Variable channel detail parts; proceed with Steps 6A through 6D, as required.
6A	Connect Ballantine Model 300 between pin 7 of V205 and chassis ground.	Meter reads 0.15 volt.	Detail parts of 30-cycle filter.
6B	Connect d-c voltmeter (500-volt range) between pin 6 of V205 and chassis ground.	Meter reads 150 volts.	Resistor R246.

TABLE 3-1. B-13A-1 CONVERTER PERFORMANCE AND TROUBLE ANALYSIS CHECK CHART - Continued

Step	Procedure	Normal Indications	Possible Cause of Abnormal Indications
		VARIABLE CHANNEL TEST - Continued	
6B (cont)	Connect Ballantine Model 300 between pin 6 of V205 and chassis ground.	Meter reads 8 volts.	
6C	Connect Ballantine Model 300 between pin 7 of V201B and chassis ground.	Meter reads 1.2 volts.	Detail parts of 60-cycle filter.
6D	Connect d-c voltmeter (500-volt range) between pin 6 of V201B and chassis ground.	Meter reads 220 volts.	Resistor R252. Capacitors C207B, C233. Transformer T202.
	Connect Ballantine Model 300 between pin 6 of V201B and chassis ground.	Meter reads 45 volts.	
7	Connect Ballantine Model 300 between J201 and J202.	Meter reads between 3.6 and 4.0 volts.	Tubes V201A, V203A, V203B, V204A, V205A, V204B. Reference channel detail parts; measure input and output a-c and d-c voltages and compare with values shown in Figure 6.
		VAR-LOC CIRCUIT TESTS	
8	Same as Steps 1 through 4, except set control unit OMNI-VAR LOC switch to VAR LOC.	Same as Steps 1 through 4.	Same as Steps 1 through 4.
9	Set the H-14 function or H-14A MODULATION switch to AMP LOC ↓ (needle center).	The IN-10 vertical pointer centers. Vertical pointer flag alarm out of sight. (If a 0-1 ma 1000-ohm meter is used to replace the flag movement, its reading should be between 0.28 and 0.32 ma for a "needle center" position.)	Balance resistor R264 misadjusted; readjust to obtain on-course reading. LOC FLAG resistor R269 misadjusted; readjust to obtain a reading of 0.3 ma. Crystal diode CR211.
10	Set the H-14 function or H-14A MODULATION switch to AMP LOC ↙ (needle left).	The IN-10 vertical pointer swings left to the outer edge of the blue sector. Vertical pointer flag alarm is out of sight. (This condition corresponds to 90 microamperes in the meter movement. A 1000-ohm 150-0-150 microammeter may be substituted for the IN-10 cross-pointer meter section, if desired.)	Sensitivity resistor R257 misadjusted; readjust to obtain proper "needle left" indication.
11	Set the H-14 function or H-14A MODULATION switch to AMP LOC ↘ (needle right).	The IN-10 vertical pointer swings right to the outer edge of the yellow sector within about one needle-width (meter current should be 90 ±5 microamperes). Vertical pointer flag alarm is out of sight.	If more than one needle-width in error, readjust sensitivity resistor R257 to split error in half between left and right sectors. If not possible to adjust R257 or R264 properly, detail parts of VAR-LOC circuit may be faulty; measure input and output a-c and d-c voltages and compare with values shown on Figure 6.

TABLE 3-1. B-13A-1 CONVERTER PERFORMANCE AND TROUBLE ANALYSIS CHECK CHART - Continued

Step	Procedure	Normal Indications	Possible Cause of Abnormal Indications
	VOR FLAG EMPHASIZER CIRCUIT TESTS		
12	Set the H-14 function or H-14A MODULATION switch to 30~.	The vertical needle flag alarm is fully visible.	Tube V207B. Resistor R270.
13	Set the H-14 function or H-14A MODULATION switch to 9960~.	The vertical needle flag alarm is fully visible.	Tube V207A. Resistor R270.
14	Set the H-14 function or H-14A MODULATION switch to OMNI.	The vertical needle flag alarm is completely out of sight.	Tube V207. Flag emphasizer circuit detail parts.

3-3. ALIGNMENT.

Preliminary Procedure. Before proceeding to align the B-13A-1 Converter, make the following tests and adjustments:

Step 1. Interconnect the test equipment and the B-13A-1 under test as shown in Figure 4-3 of the Type 15D or Figure 5-3 of the Type 15E instruction book.

Step 2. Turn the equipment on and allow a 15-minute warm-up period to ensure stabilization.

Step 3. With a d-c voltmeter (0-30 volt range) connected between the receiver test harness LV+ and G test points, adjust the primary source voltage to produce a reading of 27.5 volts for a 28-volt B-13A-1, or 13.75 volts for a 14-volt B-13A-1.

Step 4. With the Ballantine Model 300 connected between the converter test harness NAV MOD V. and G test points, and with the NAV MOD SOURCE switch set to EXTERNAL, adjust the H-14 or H-14A Signal Generator for "level set" indications of the r-f level and the individual 30-cycle and 9960-cycle modulations as outlined in the H-14 or H-14A instruction book. Then with the H-14 function switch set to 30~ MOD, or the H-14A MODULATION switch set to 30~, adjust the signal generator DEMOD output to obtain a NAV MOD V. reading of 1.8 volts. Set the function or MODULATION switch to OMNI.

Step 5. Turn R226 to its extreme counterclockwise position, and set R225 and R239 approximately at mid position.

Note

It is assumed that prior to alignment all electron tubes have been tested. Defective tubes should be replaced and nondefective tubes returned to their original sockets. If satisfactory alignment of the B-13A-1 Converter cannot be achieved, refer to Table 3-1.

Adjustment of VOR Section. Before adjusting the VOR section of the B-13A-1 Converter, perform the preliminary procedures outlined previously in this paragraph; then perform the adjustments described in the following paragraphs.

Adjustment of Variable Channel. Connect the Ballantine Model 300 vtvm between B-13A-1 test jacks J202 and J203. With the H-14 function switch, or H-14A MODULATION switch set to OMNI, adjust the variable channel output voltage by means of VAR LEVEL control R250 to approximately 4 volts.

Adjustment of Reference Channel and Phase Comparison Circuit. To adjust the reference channel and phase comparison circuit, proceed as follows:

Step 1. With Signal Generator H-14 or H-14A set to OMNI, make a preliminary aduustment of BAL potentiometer R239 to obtain an on-course indication on the IN-10 which is equivalent to zero current.

Step 2. Set the signal generator function switch to OMNI, the OMNI TRACK switch to 0°, and the IN-10 Course Indicator to 191.5°.

Step 3. Connect the Ballantine Model 300 between test jacks J201 and J202, and adjust REF LEVEL potentiometer R226 to obtain a reading of approximately 4.0 volts.

Step 4. Adjust PHASE potentiometer R225 for an on-course indication on the IN-10.

Step 5. Set the signal generator OMNI TRACK switch to 180°. The IN-10 vertical needle should remain centered (on-course); if not, readjust BAL potentiometer R239 to reduce the off-center error by one half.

Step 6. Repeat the adjustments of R225, at a 0° ANGLE TO track; and of R239, at a 180° track (Steps 3, 4, and 5, of this procedure); until an on-course indication is obtained at both 0° and 180°. Lock R239, taking care not to disturb its setting.

Adjustment of Course Sensitivity. To adjust the course sensitivity, proceed as follows:

Step 1. Set the H-14 or H-14A OMNI TRACK switch at 0° and set the IN-10 to 181.5°. Adjust REF LEVEL control R226, if necessary, to obtain a "5-dot" deflection of the IN-10 vertical needle to the right (yellow) side, which corresponds to 150 microamperes. Reset PHASE control R225 for an on-course indication with the IN-10 set to 191.5°. Repeat the procedure if necessary.

Step 2. Measure the reference channel output voltage with the Ballantine Model 300 connected between test jacks J201 and J202. If it is not within 0.5 volt of the variable channel output (4 volts), adjust the VAR LEVEL potentiometer, R250, to produce the required balancing of these outputs.

Note

As the variable channel output (J202 and J203) is raised, the reference channel output (J202 and J201) must be decreased (and vice versa) to maintain the proper off-course deflection of 10°. Therefore, the "5-dot" deflection for 10° off-course must be rechecked whenever the setting of either R226 or R250 is changed. If R250 was readjusted in this step, repeat Steps 4 and 5 of the reference channel and phase comparison circuit adjustment and then lock R239, R226, R225, and R250.

Check of Reference Channel Limiter and Other Circuits. Connect a Ballantine Model 300 between pin 7 of V203A and chassis ground. After the reference-channel and phase-comparison circuit adjustment and the course-sensitivity adjustment have been completed, a reading within the limits of 0.9 and 1.1 volts should be obtained if the reference channel circuits beyond this test point are functioning properly. Also, if the limiter and the 10-kc amplifier, V201A, are functioning properly, the voltage as read on the vtvm between pin 4 of V201A and chassis ground should be within the limits of 2.8 and 3.4 volts. If either or both of these voltages are out of limits, it is an indication of trouble.

Adjustment of Phase-Splitter Network to Minimize Quadrantal Errors.

Caution

Do not attempt this critical adjustment unless R222 has been damaged, or R221 or C210 has been replaced, or the presence of excessive quadrantal error has been positively determined experimentally.

Adjust the phase-splitting network to minimize quadrantal error as follows:

Step 1. Set the H-14 or H-14A OMNI TRACK switch to 30° and adjust the IN-10 for an on-course indication of the vertical needle. The IN-10 should read very close to 222° (30° plus 191.5°; refer to paragraphs 4-19 through 4-21 of the Type 15D or paragraph 5-3 of the Type 15E instruction book). If it does not, subtract 222° from the actual reading and record the difference with proper algebraic sign.

Step 2. Set the signal generator OMNI TRACK switch to 60°. Readjust the IN-10 to approximately 252° for an on-course vertical needle indication, and again record the difference.

Step 3. Repeat the measurements of Step 2 for each successive 30° angle (that is, 90, 120, 150, etc.) around the OMNI TRACK switch, recording the errors of indication as in the previous steps.

Step 4. Plot a curve of errors as calculated (in degrees) against the setting of the OMNI TRACK switch. If the value of R222 is not optimum, an average curve similar to one of the curves shown in Figure 4-4 of the

Type 15D or Figure 5-4 of the Type 15E instruction book will result. In an ideal curve of this type, the peak-to-peak distance "h" of the applicable illustration will be zero.

Note

Small random errors will cause the observed points to scatter around such an average curve. Attempt to average out these errors in plotting the curve.

Step 5. If the peak-to-peak distance "h" of the applicable illustration is not close to zero, reduce "h" to a minimum by proceeding as follows: If the plotted curve is similar to A of the applicable illustration, decrease R222 by an amount equal to "h" (in degrees) x 10,000 ohms; if the plotted curve is similar to B, increase R222 by an amount equal to "h" (in degrees) x 10,000 ohms.

Step 6. After changing R222 by the amount calculated in Step 5, plot a new quadrantal error curve (Steps 1 through 4) to confirm the resultant value of R222.

Step 7. When the quadrantal error curve has been made as nearly a straight line as possible, set the signal generator OMNI TRACK switch to 90° and set the IN-10 to 282°.

Step 8. Unlock R225 and adjust it for an on-course vertical needle indication, or as required to give minimum error averaged around the compass degrees. Lock R225 taking care not to distrub its setting.

Adjustment of VOR Flag-Alarm Circuit. To adjust the VOR flag-alarm circuit, proceed as follows:

Step 1. Set the signal generator's individual 30-cycle and 9960-cycle modulation percentages at 10 per cent. Set the H-14 function switch or the H-14A MODULATION switch to OMNI.

Step 2. Adjust B-13A-1 VOR FLAG potentiometer R268 until the IN-10 vertical pointer warning flag just begins to show. Lock R268 taking care not to disturb its setting.

Step 3. Set the H-14 or H-14A individual 30-cycle and 9960-cycle modulation percentages at 30 per cent. The IN-10 vertical pointer warning flag should be completely out of sight.

Overall Performance Check. Check for course accuracy around the full circle, and for flag alarm and to-from meter operation as described in Table 3-1.

Adjustment of VAR-LOC Section. To adjust the VAR-LOC section of the B-13A-1, proceed as follows:

Step 1. Interconnect the test equipment and the B-13A-1 under test as shown in Figure 4-3 of the Type 15D or Figure 5-3 of the Type 15E instruction book.

Step 2. Set the control unit OMNI-VAR LOC switch to VAR LOC.

Step 3. Apply low-voltage power and allow the equipment to warm up for 15 minutes.

Step 4. Apply 1.8 volts of AMP LOC ⓘ (needle center) modulation from the H-14 or H-14A Signal Generator to the receiver test harness EXT NAV MOD input.

Step 5. Set SENS potentiometer R257 at approximately a two-thirds clockwise position and adjust BAL potentiometer R264 to obtain an on-course indication on the IN-10. (R257 and R264 are located on the front panel of the B-13A-1.)

Step 6. Set the signal generator modulation to AMP LOC ⓛ (needle left) and adjust R257 until the IN-10 vertical needle lies at the outer edge of the blue sector on the IN-10 dial. (This position corresponds to 90 microamperes. If desired, a 1000-ohm, 150-0-150 microammeter may be used in place of the IN-10 cross-pointer meter section.)

Step 7. Set the signal generator to AMP LOC ⓡ (needle right). The vertical needle should lie at the outer edge of the yellow sector, plus or minus about one needle width. The equivalent meter current should be 90 (±5) microamperes. If the needle differs from the specified deflection, readjust R257 to reduce the difference by one half. Lock R257 and R264, taking care not to disturb their settings.

Step 8. Set the signal generator's individual 90-cycle and 150-cycle modulation percentages at 10 per cent, and set the signal generator modulation switch to ⓘ (needle center).

Step 9. Adjust LOC FLAG potentiometer R269 until the IN-10 vertical pointer warning flag just begins to

show. Lock R269, taking care not to disturb its setting.

Step 10. Set the signal generator's individual 90-cycle and 150-cycle modulation percentages at 20 per cent. The IN-10 vertical pointer warning flag should be completely out of sight.

Step 11. Check all the AMP LOC needle settings of the signal generator. The on-course indication, at 0 (±2) microamperes, should not be detectable in error; the "needle left" and "needle right" positions, at 85 to 95 microamperes meter current each, should be short of the ends of their respective colored sections by about two needle widths. Residual errors should be approximately balanced on both sides. In all settings, the flag alarm should be completely out of sight.

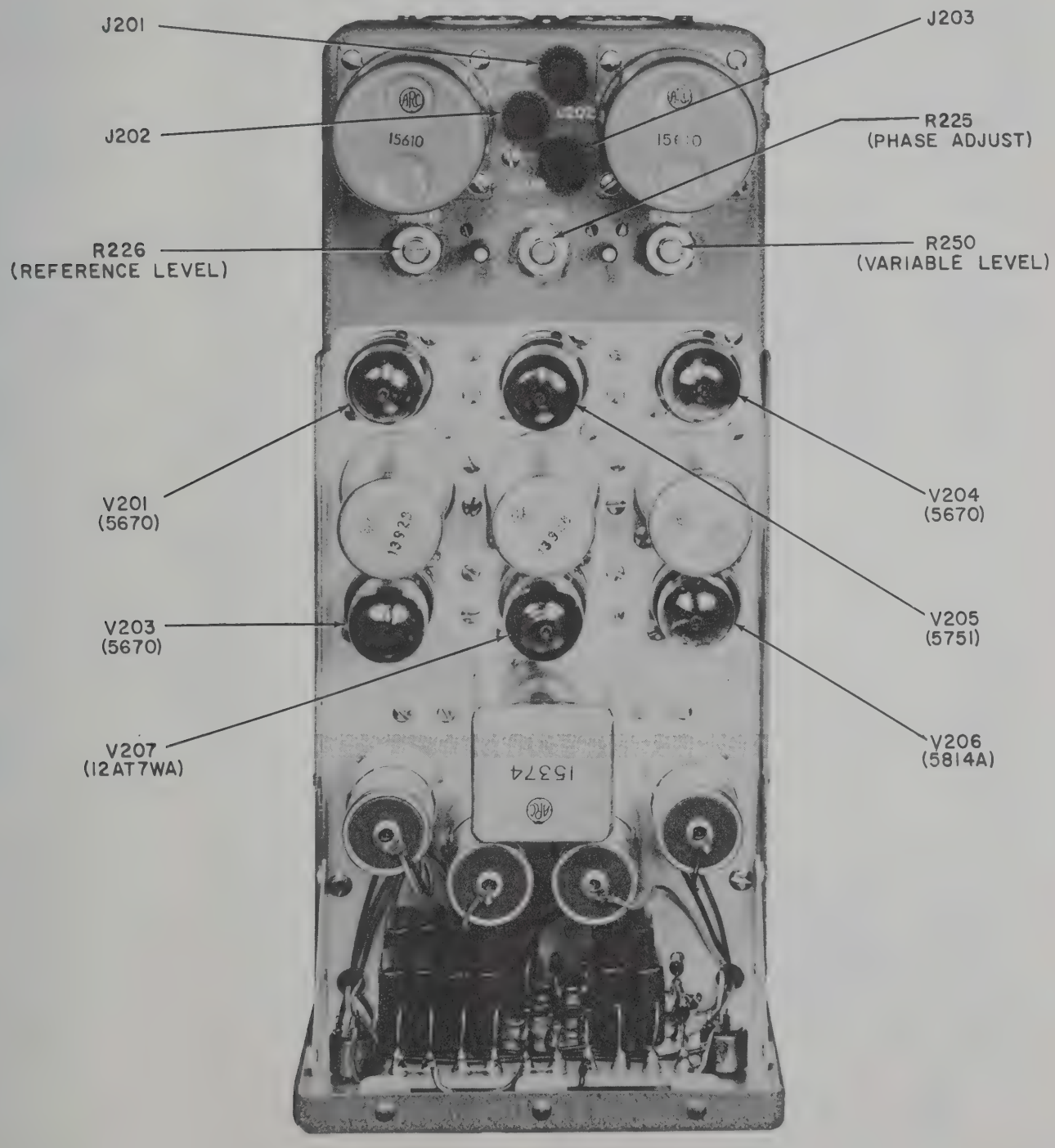
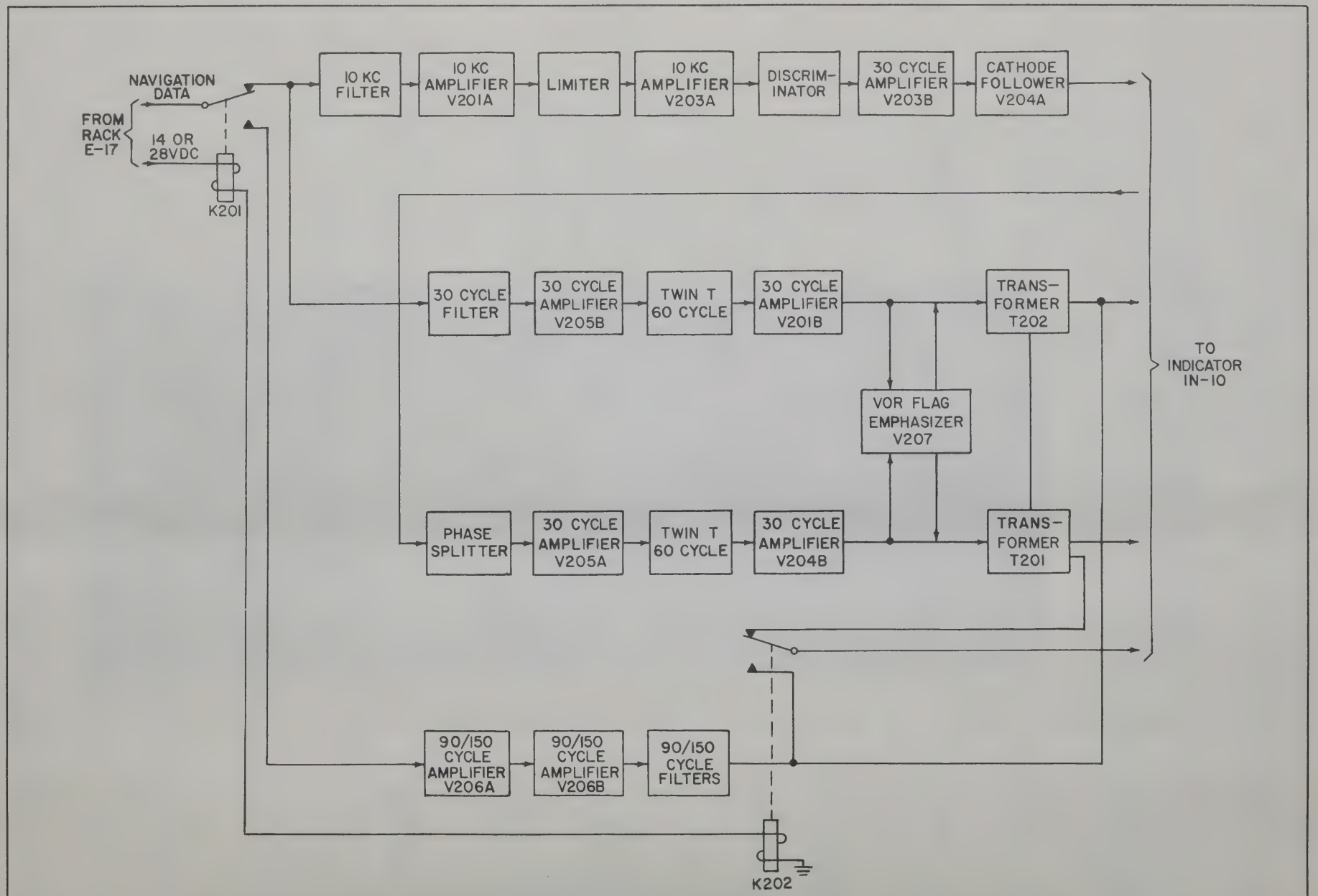


Figure 2. ARC Type B-13A-1 Converter, Top Interior View



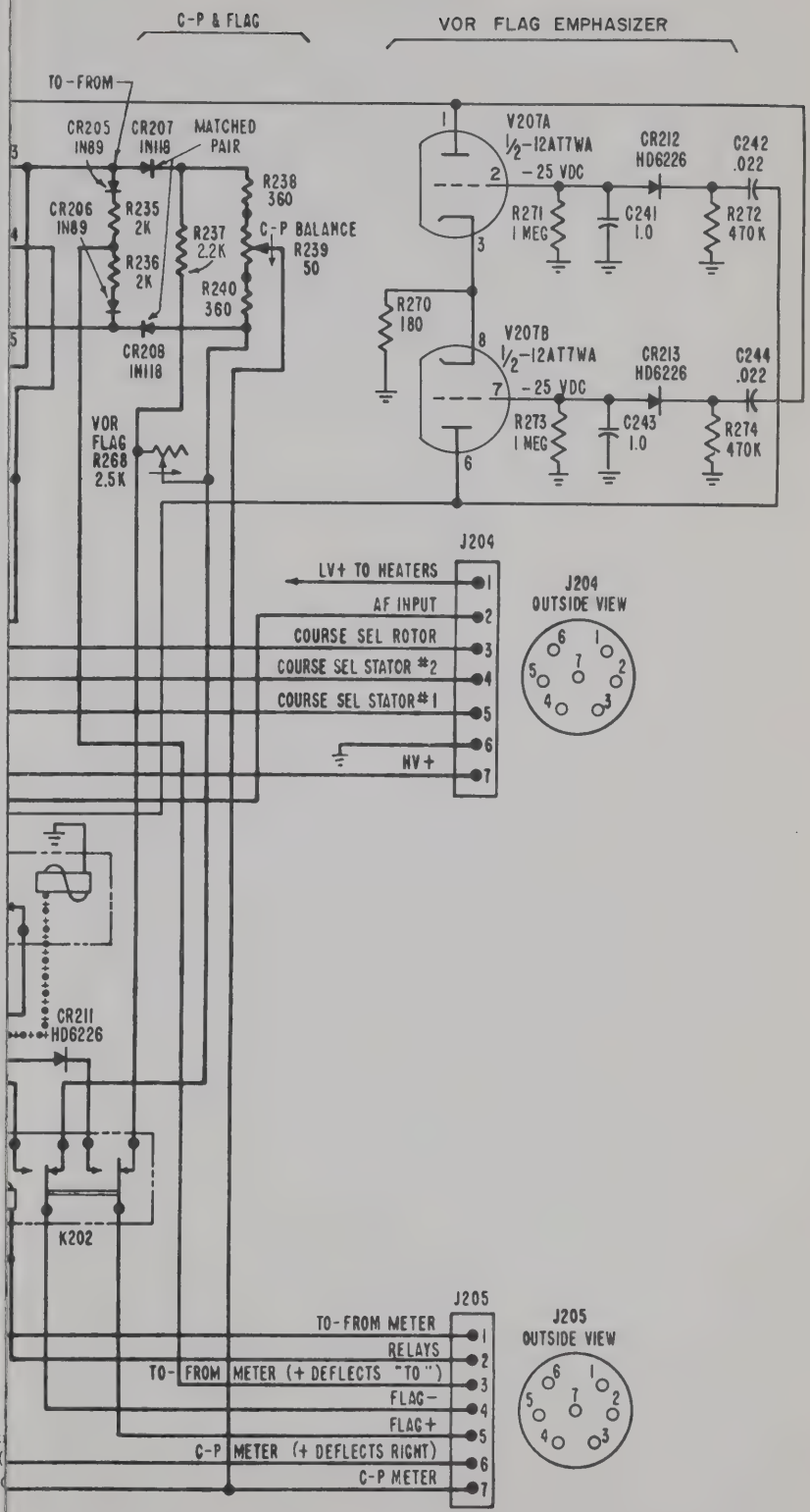
TP1596

Figure 3. ARC Type B-13A-1 Converter, Block Diagram

Symbol No.	ARC Part No.
C201	8617(0201)
C202	8577
C203	8577
C204	8577
C205	8577
C206	8577
C207A C207B	13928
C208	8577
C209A C209B	13928
C210	8577
C211	8618(9364)
C212	8577
C213	8577
C214	8577
C215	8577
C216	8577
C217	8577
C218	16143
C219A C219B	13928
C220	15763
C221	8577
C222	8577
C223	8577
C224	8577
C225	8618(9244)
C226	8577
C227	8577
C228	8577
C229	8577
C230	8577
C231	8577
C232	8577
C233	15763
C234	16143
C235	16653
C236	8577
C237	8577
C238	16143
C239	16143
C240	8617 or 8618
C241	21485(9101)
C242	8911(9223)
C243	21485(9101)
C244	8911(9223)
CR201	16660
CR202	16660
CR203	16660
CR204	16660
CR205	16660
CR206	16660
CR207	16670
CR208	16670
CR209	16665
CR210	16665
CR211	23037
CR212	23037
CR213	23037

[1]Value selected at time of final adjust
substitute value in place of asterisk(

[2]ARC-16643 is for 14-volt model; AR(



22902B

Figure 4. ARC Type B-13A-1 Converter, Schematic Diagram

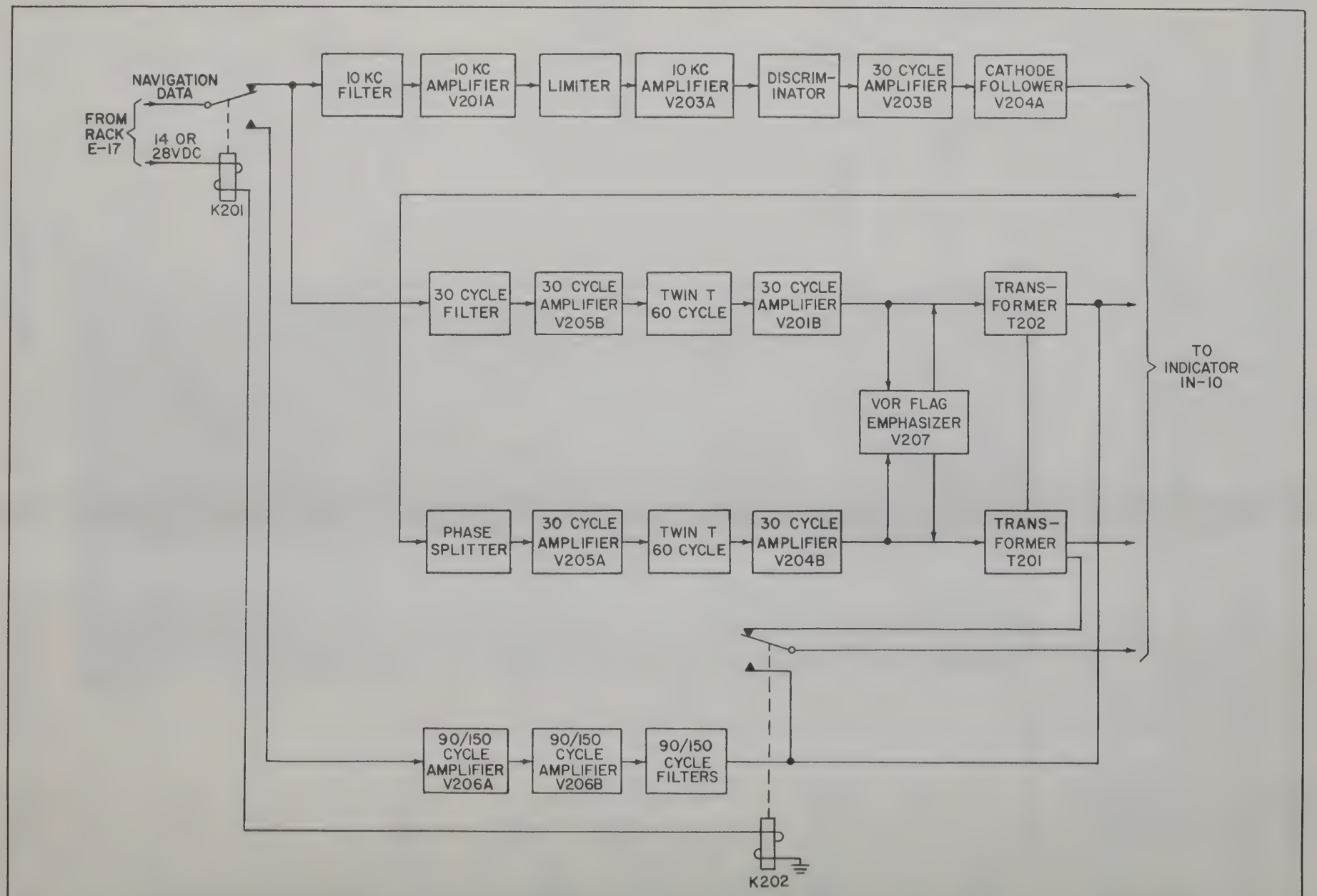


Figure 3. ARC Type B-13A-1 Converter, Block Diagram

TP1596

Symbol No.	ARC Part No.
C201	8617(0201)
C202	8577
C203	8577
C204	8577
C205	8577
C206	8577
C207A	13928
C207B	
C208	8577
C209A	13928
C209B	
C210	8577
C211	8618(9364)
C212	8577
C213	8577
C214	8577
C215	8577
C216	8577
C217	8577
C218	16143
C219A	13928
C219B	
C220	15763
C221	8577
C222	8577
C223	8577
C224	8577
C225	8618(9244)
C226	8577
C227	8577
C228	8577
C229	8577
C230	8577
C231	8577
C232	8577
C233	15763
C234	16143
C235	16653
C236	8577
C237	8577
C238	16143
C239	16143
C240	8617 or 8618
C241	21485(9101)
C242	8911(9223)
C243	21485(9101)
C244	8911(9223)
CR201	16660
CR202	16660
CR203	16660
CR204	16660
CR205	16660
CR206	16660
CR207	16670
CR208	16670
CR209	16665
CR210	16665
CR211	23037
CR212	23037
CR213	23037

Symbol No.	ARC Part No.
J201	13152
J202	12921
J203	13152
J204	5488
J205	5488
K201	12712
K202	12712
R201	201(0105)
R202	201(0162)
R203	201(0513)
R204	201(0622)
R205	201(0224)
R206	201(0104)
R207	201(0622)
R208	201(0514)
R209	201(0911)
R210	201(0105)
R211	201(0513)
R212	201(0513)
R213	205(0334)
R214	201(0510)
R215	201(0152)
R216	201(0513)
R217	201(0513)
R218	205(0105)
R219	201(0103)
R220	201(0103)
R221	8578
R222	201(*)
R223	201(0105)
R224	205(0104)
R225	8247
R226	8573
R227	201(0152)
R228	201(0104)
R229	205(265K)
R230	205(133K)
R231	205(265K)
R232	201(0105)
R233	201(0182)
R234	201(0512)
R235	201(0202)
R236	201(0202)
R237	201(0222)
R238	205(0361)
R239	8654
R240	205(0361)
R241	205(0474)
R242	205(0514)
R243	201(0205)
R244	205(0105)
R245	201(0182)
R246	201(0104)
R247	205(265K)
R248	205(133K)
R249	205(265K)
R250	8655
R251	201(0182)
R252	201(0513)
R253	201(0113)

Symbol No.	ARC Part No.
R254	204(0105)
R255	205(0105)
R256	201(0202)
R257	8662
R258	204(0105)
R259	205(1.33MEG)
R260	201(0821)
R261	201(0153)
R262	201(0561)
R264	8573
R265	201(0561)
R266	[2]16643
	[2]16644
R267	202(0511)
R268	8737
R269	8737
R270	201(0181)
R271	201(0105)
R272	201(0474)
R273	201(0105)
R274	201(0474)
T201	15610
T202	15610
V201	700(0120)
V202	700(0202)
V203	700(0120)
V204	700(0120)
V205	700(0125)
V206	700(0126)
V207	700(0173)
XV201	15230
XV203	15230
XV204	15230
XV205	15230
XV206	15230
XV207	15230
Z201	15374
Z202	15890
Z203	15891

[1]Value selected at time of final adjustment. To complete part number, substitute value in place of asterisk(*).

[2]ARC-16643 is for 14-volt model; ARC-16644 is for 28-volt model.

NOTES:

1. FOR WIRING DIAGRAM, SEE FIGURE 5.
2. CAPACITOR VALUES ARE IN MICROFARADS UNLESS OTHERWISE NOTED.
3. RESISTOR VALUES ARE IN OHMS; MULTIPLIERS K=1,000 AND MEG=1,000,000.
4. FOR 28-VOLT POWER SOURCE, WIRES MARKED (++++) ARE CONNECTED AND WIRES MARKED (. . . .) ARE OMITTED.
5. FOR 14-VOLT POWER SOURCE, WIRES MARKED (. . . .) ARE CONNECTED AND WIRES MARKED (++++) ARE OMITTED.
6. A-C AND D-C VOLTAGES ARE APPROXIMATE AND ARE BASED ON THE FOLLOWING CONDITIONS:
   - A. D-C VOLTAGES ARE OBTAINED WITH A 20,000 OHMS-PER-VOLT VOLTMETER AND WITH LV+ SET AT THE NOMINAL SUPPLY VOLTAGE OF 14 VOLTS OR 28 VOLTS. VOLTAGES WILL BE SLIGHTLY HIGHER FOR 28-VOLT EQUIPMENT THAN FOR 14-VOLT EQUIPMENT.
   - B. A-C VOLTAGES ARE OBTAINED WITH A BALLANTINE MODEL 300 ELECTRONIC VOLTMETER. VOLTAGES ARE MEASURED TO GROUND WITH THE EXCEPTION OF T201 AND T202 SECONDARY VOLTAGES WHICH ARE MEASURED TO COMMON CENTER TAP.
7. ARROWS ON GERMANIUM DIODES SHOW DIRECTION OF CURRENT FLOW.
8. VALUES OF THE FOLLOWING PARTS ARE SELECTED AND INSTALLED AT TIME OF FINAL ADJUSTMENT:

SYMBOL NO.	LIMITING VALUE	PURPOSE
R222	0-20K	MINIMIZE QUADRANTAL ERROR
C240	0-0.002 μF	CENTER PHASE ADJUSTING CONTROL

9. RELATIVE PHASE ANGLES OF VARIOUS 30-CPS VOLTAGES ARE MEASURED WITH RESPECT TO THE A-F INPUT VOLTAGE WITH THE COURSE SELECTOR SET FOR A 191° ON-COURSE (TO) INDICATION.

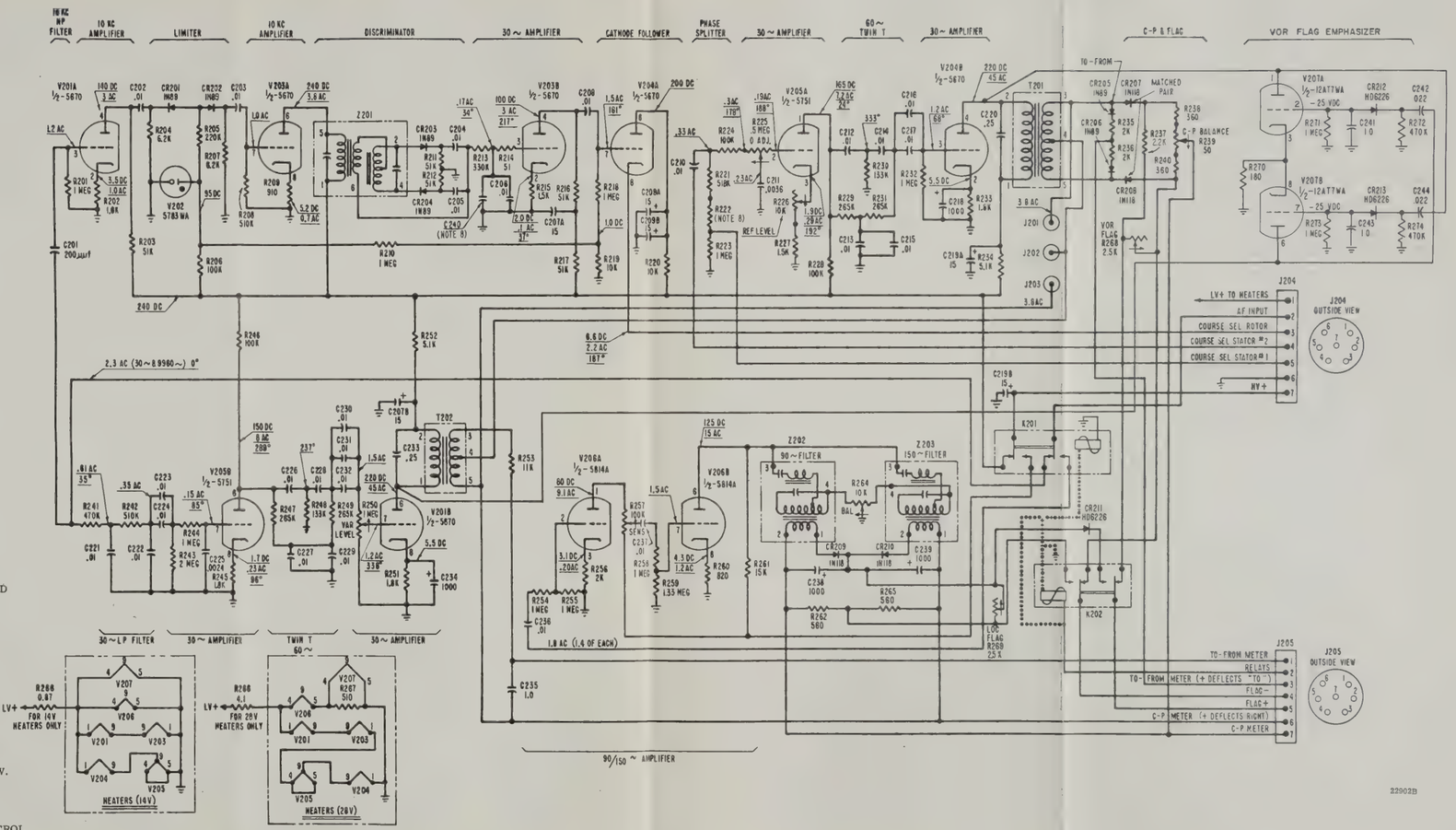
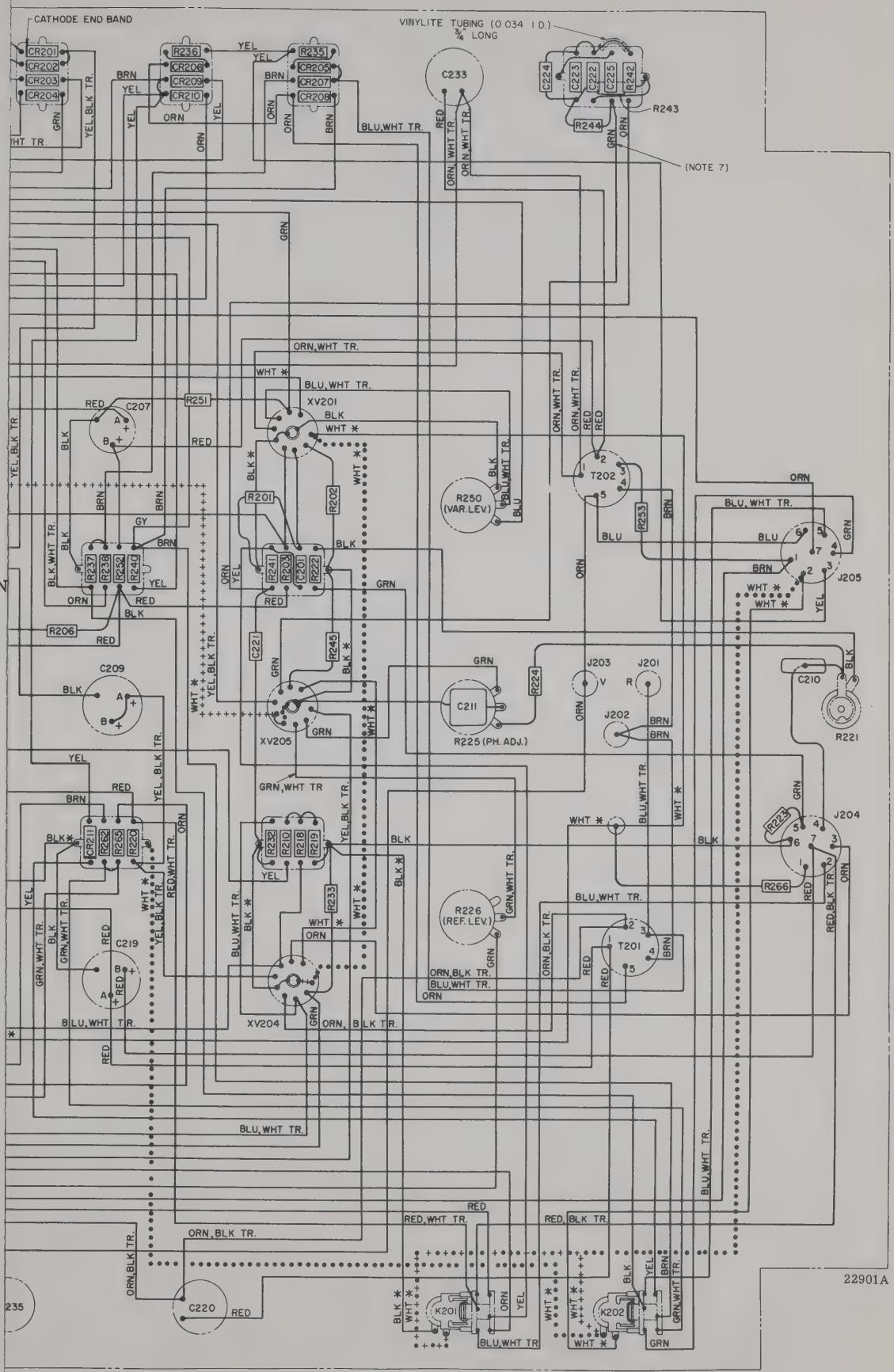


Figure 4. ARC Type B-13A-1 Converter, Schematic Diagram

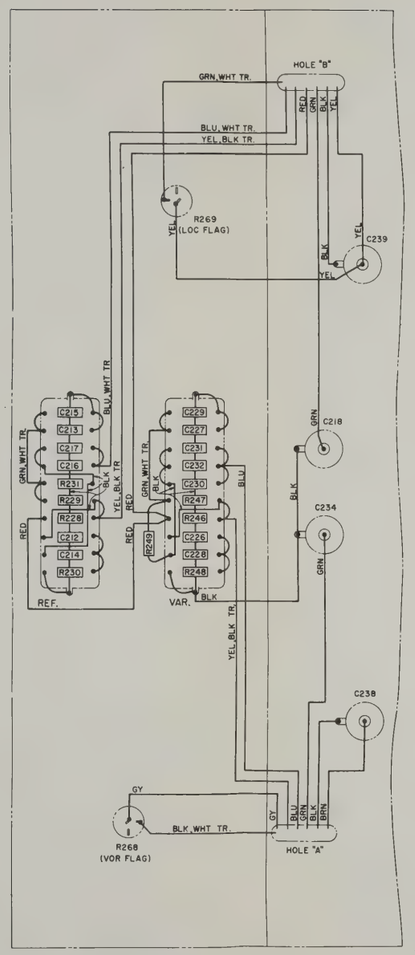


ING BELOW TUBE DECK

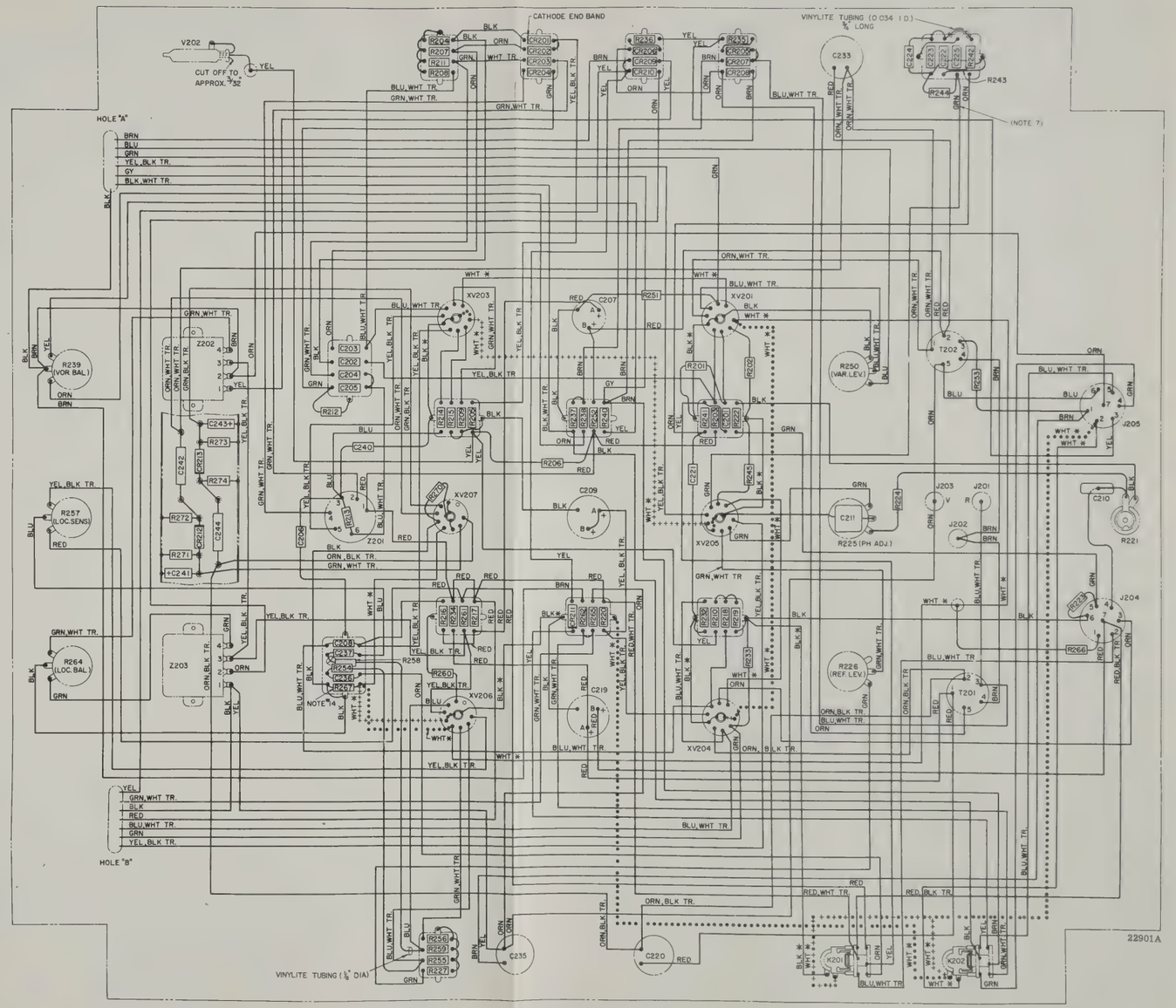
Figure 5. ARC Type B-13A-1 Converter, Wiring Diagram

NOTES:

1. FOR SCHEMATIC DIAGRAM, SEE FIGURE 4:
2. WIRES MARKED WITH COLOR NOTE ARE NO. 24, VINYLITE INSULATED EXCEPT THOSE MARKED WITH AN ASTERISK (*) WHICH ARE NO. 22, VINYLITE INSULATED.
3. UNMARKED WIRES ARE NO. 22 BARE, TINNED COPPER.
4. FOR 28-VOLT POWER SOURCE, WIRES MARKED (+++) ARE CONNECTED AND WIRES MARKED (. . .) ARE OMITTED.
5. FOR 14-VOLT POWER SOURCE, WIRES MARKED (. . .) ARE CONNECTED AND WIRES MARKED (+++) ARE OMITTED.
6. RESISTOR R267 USED ON 28-VOLT EQUIPMENT ONLY.
7. LAY WIRE DIRECTLY AGAINST CHASSIS.

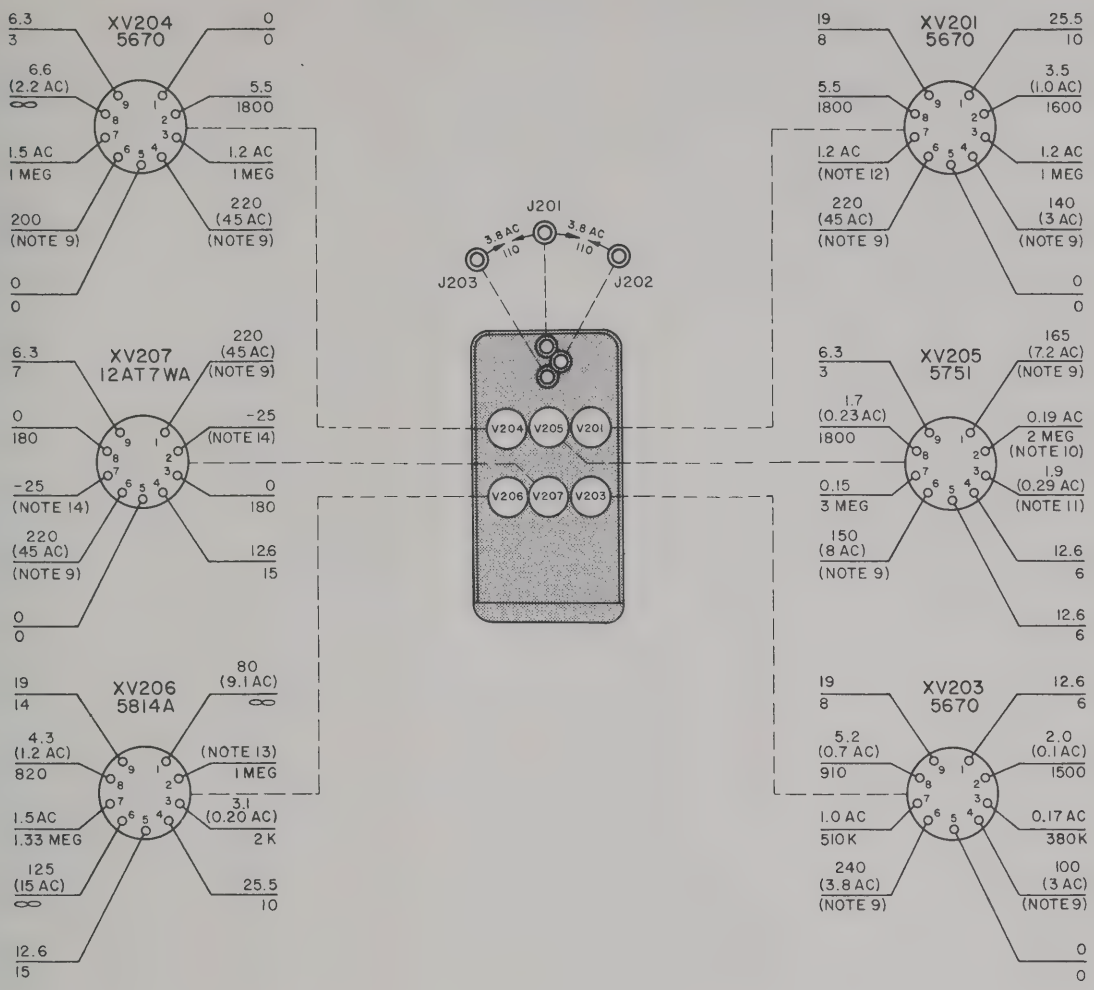


WIRING ABOVE TUBE DECK



WIRING BELOW TUBE DECK

Figure 5. ARC Type B-13A-1 Converter, Wiring Diagram



NOTES:

1. VIEW IS BOTTOM OF CHASSIS.
2. VOLTAGES ARE DC, UNLESS OTHERWISE NOTED, AND APPEAR ABOVE THE REFERENCE LINE.
3. RESISTANCE VALUES ARE IN OHMS (MULTIPLIERS: K=1000; MEG=1,000,000) AND APPEAR BELOW THE REFERENCE LINE.
4. MEASUREMENTS ARE MADE WITH RESPECT TO GROUND EXCEPT J201 AND J203 WHICH ARE MADE WITH RESPECT TO J202.
5. RESISTANCE MEASUREMENTS ARE MADE WITH B-13A-1 DISCONNECTED FROM SYSTEM.
6. VOLTAGE MEASUREMENTS ARE MADE WITH B-13A-1 CONNECTED IN SYSTEM, AND WITH HIGH VOLTAGE SUPPLIED BY DYNAMOTOR ARC TYPE D-10A INSTALLED ON RECEIVER.
7. D-C VOLTAGE MEASUREMENTS ARE MADE WITH 20,000 OHMS-PER-VOLT VOLTMETER, SUCH AS SIMPSON MODEL 260 OR WESTON MODEL 790, WITH LV+ SET AT THE NOMINAL SUPPLY VOLTAGE OF 14 OR 28 VOLTS. VOLTAGES ARE APPROXIMATE AND WILL BE SLIGHTLY HIGHER FOR 28-VOLT EQUIPMENT THAN FOR 14-VOLT EQUIPMENT. FILAMENT VOLTAGE MEASUREMENTS MADE WITH 28-VOLT LV+ SUPPLY.
8. A-C VOLTAGE MEASUREMENTS ARE MADE WITH BALLANTINE MODEL 300 VACUUM TUBE VOLTMETER, AND WITH "STANDARD" TEST SIGNAL LEVELS OF 1.8 VOLTS (±0.1 VOLT) AT 30 CPS, AND 1.8 VOLTS (±0.2 VOLT) AT 9960 CPS.
9. NO SIGNIFICANT MEASUREMENT DUE TO CAPACITOR CHARGING.
10. DEPENDS ON VALUE OF R222 AND SETTING OF R225.
11. DEPENDS ON VALUE (SETTING) OF R226.
12. DEPENDS ON VALUE (SETTING) OF R250.
13. NO SIGNIFICANT MEASUREMENT. 1.8 AC ON INPUT SIDE OF C236 WITH RELAY K201 ACTUATED.
14. RESISTANCE WILL DEPEND ON METER CONNECTIONS; SHOULD BE 1MEG OR 320K OHMS.

Figure 6. ARC Type B-13A-1 Converter, Voltage and Resistance Diagram

TP1598

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April 1959

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Test Procedure

FOR

ARC TYPE 15C VHF NAVIGATIONAL RECEIVING EQUIPMENT

AIRCRAFT RADIO CORPORATION
BOONTON • NEW JERSEY

PRINTED IN U.S.A.

MAY 1951

TEST PROCEDURE

for

ARC TYPE 15C VHF NAVIGATIONAL RECEIVING EQUIPMENT

I. INTRODUCTION

Aircraft Radio Corporation Type 15C VHF Navigational Receiving Equipment consists of three major units: Receiver (R-13B), Converter (B-10A) and Filter Amplifier (F-10A), and the following auxiliary electrical components: Rack (E-13B), Control Box (C-22A), Cross Pointer Meter and Course Selector/TO-FROM Meter. These components have been designed and adjusted to be individually interchangeable, that is, any unit in a system may be replaced by a properly functioning unit of the same type number without upsetting the overall calibration of the system. Because of this requirement each unit must be adjusted to meet standard performance requirements.

The following sections describe the tests and adjustments necessary to assure standard performance of each unit of a Type 15C installation.

II. METHODS OF TESTING

It has been found that the substitution method of locating trouble is efficient. A bench set-up of a Type 15C Equipment complete with cables, mechanical linkage, and one or two sets of "average" marked tubes will be found most helpful. With such an assembly a faulty unit can be serviced and its final adjustment checked in a standard system. Quantitative testing may be performed as hereinafter outlined.

III. TEST EQUIPMENT

A. The following is a list of the apparatus that will be required to test and service ARC Type 15C Equipment:

1. Audio Oscillator, Hewlett-Packard Model 200-B or equivalent.
2. Standard Signal Generator (for 15 mc I.F.), Ferris Model 16-C or equivalent.
3. Output Meter, General Radio Co. Type 483-C or equivalent.
4. Headphones (high impedance).
5. Test Probe (for mixer grid test jack).
6. Vacuum Tube Voltmeter. All voltages given in the tables of test limits for the Converter are based on readings of a Ballantine Voltmeter, Model 300.
7. A set of Test Harness to permit tests on, and access to, the Receiver and Converter in a position convenient for servicing on the bench.
   Rack to Receiver — ARC Part No. 15857
   Rack to Converter — ARC Part No. 15859
8. Voltohmmeter.
9. DC power source adjustable between the limits 12-14V and 26-28V.
10. A.R.C. Type H-14 Signal Generator.
11. Complete ARC Type 15C Equipment.
    Cross Pointer Meter #13310 with flags can be replaced by the following:
    a. Deviation movement — DC Microammeter, 150-0-150 ua; resistance, 1000 ohms
    b. Flag movement — DC Milliammeter, 0-1 ma; resistance, 1000 ohms

    TO-FROM Meter can be replaced by a DC Microammeter, 150-0-150 ua; resistance not critical if below 1000 ohms.

IV. OPERATION OF TEST EQUIPMENT

A. A set of test harness is required to permit easy access to the Receiver and Converter for bench servicing under operating conditions. It consists of the following:

1. Test Harness, ARC Part No. 15857. It provides the following test facilities:
   (a) A ground terminal.
   (b) Receiver Audio Output Test jack, phone jack and 300 ohm load.
   (c) A sensitivity control.
   (d) Cathode Current Meter jack.
   (e) Means for switching navigation audio input to Rack from Receiver to external source (H-14 or equivalent).

(f) An External Navigation Audio input jack.

(g) A test point on Navigation Audio input to the rack.

(h) A Low Voltage test point.

(i) A High Voltage test point.

2. Test Harness, ARC Part No. 15859. It provides the following test facilities:

(a) A ground terminal.

(b) A Low Voltage test point.

(c) A High Voltage test point.

(d) An External Navigation Audio input jack.

B. H-14 Signal Generator: The H-14 Signal Generator is designed to provide all modulated radio frequency necessary to test an omni receiving system. Circuits are provided to furnish all audio frequencies necessary to test the audio components of an omni system. The audio output DEMOD is derived from a cathode follower tube. The circuit is resistive and is not in itself subject to phase shift when feeding a resistive load. The voltage that appears at the DEMOD jack is exactly the same in wave shape and phase as the modulation envelope of the radio frequency signal. Because of the direct connection to the cathode follower circuit a DC voltage appears at this terminal in addition to the audio frequencies. When feeding a piece of equipment from the DEMOD jack this DC voltage must be considered. ARC Type B-10A Converters have a blocking condenser (C-202) in the input circuit; additional blocking is not necessary. *When feeding other equipment from the H-14, a blocking condenser may be required. The phase shift introduced by the blocking condenser and the connected load must be considered in phase measurement.*

In order to make the DEMOD output generally useful, the AC voltage is considerably higher than that required for B-10A servicing. This voltage can be adjusted between nominal values of 0.5 volt and 6.0 volts by means of the screwdriver adjustment provided by Modification HSC-510109-2. (H-14 Signal Generators after Serial No. 62 have this control installed.) Desired voltage may be obtained from the DEMOD jack by adjustment of this control. All DEMOD voltages must be measured with the load connected to the DEMOD output.

The following is a list of operations required to set up the H-14 Signal Generator for bench testing of Type 15C Equipment:

1. Turn on power.
2. Turn standby-operate switch to "operate."
3. Set function switch at RF.
4. Set MC switch to lower frequency (A).
5. Tune trimmers "A" for max RF meter reading.
6. Set MC switch to higher frequency (B).
7. Tune trimmers "B" for max RF meter reading.
8. Zero set meters (MOD and RF).
9. Adjust RF level for red line RF meter indication.
10. Set function switch at 9960~.
11. Adjust 9960~ MOD control for red line reading of MOD meter.
12. Set function switch at 30~.
13. Adjust 30~ MOD control for red line reading of MOD meter.
14. Set function switch to position required to provide desired output.

ALIGNMENT PROCEDURE
for
AIRCRAFT RADIO CORPORATION RECEIVER
TYPE R-13B

V. PROCEDURE

A. Warm up receiver for ten minutes at rated supply voltage, maximum gain, prior to alignment. Leave at maximum gain, rated supply voltage, for following procedure. Audio output voltmeter is across 300-ohm load.

B. *Sense and Preferred Setting of all Trimmer Condensers.*

When a receiver is aligned at the factory, all trimmers are left in such a position that further rotation clockwise will *increase* capacity. Alignment of arrowhead (or line) on rotor shaft with fiducial line corresponds to maximum capacity.

C. Connect 5-ohm Signal Generator source through test probe to mixer grid test jack, and to adjacent ground. Adjust signal generator frequency to 15 MC ±.01%, set modulation to 30% at 400~ and set Receiver dial to 131 Mc. Beginning with the 4th IF coupling unit, make a preliminary alignment of all eight IF trimming condensers by adjusting each one for maxi-

mum output. Keep the maximum output of the Receiver below 2 volts in 300-ohm (see IV A1b) load by appropriate adjustment of signal generator output level during this trimming process. Make the final IF alignment as follows: Detune the input (#1) trimmer of the 4th IF coupling unit in whichever direction gives the maximum detuning and then adjust the output (#2) trimmer of the same unit for maximum output. Then, without any readjustment of #2 trimmer, reduce input to as low a level as will provide a satisfactory indication on the output meter and adjust #1 trimmer for maximum output. Keep the maximum output below 2 volts by appropriate adjustment of signal generator output level during this trimming process. Repeat the final alignment process just described for the 4th IF coupling unit successively on the 3rd, 2nd and 1st IF coupling units. Screw on top caps and remove signal generator connections.

D. The preselector assembly coil adjustments have already been made at the factory. Connect H-14 Signal Generator attenuator output to coax input on the R-13B Receiver. Adjust H-14 Signal Generator frequency to 131 Mc ±.01% (by installing 131 Mc crystal in H-14 and tuning H-14 to resonance), tune receiver to H-14 signal, use 30% modulation at 400 ~ as described in paragraph VI-B and adjust RF oscillator trimmer condenser for maximum output. Then adjust the three RF amplifier trimmers for maximum output in the order 2nd, 1st, antenna. Keep the maximum output below 2 volts in 300 ohms by appropriate adjustment of signal generator output level during this trimming process.

E. Check dial frequency calibration at low alignment frequency as follows: Set H-14 Signal Generator frequency to 111 Mc ±.01%, by installing crystal and retuning H-14. Use 30% modulation at 400~, and tune receiver dial in region of 111 Mc for maximum output. If the ARC Type H-14 Signal Generator is used for this procedure, crystals for 131 Mc, 121 Mc, and 111 Mc should be on hand and used for the check points.

IMPORTANT NOTE

H-14 SIGNAL GENERATORS THROUGH SERIAL #60 WILL NOT TUNE UP ON 131 MC. THEREFORE, WHERE HIGH DIAL (131 MC) TESTS ARE CALLED OUT, SOME OTHER SOURCE OF RF ENERGY SHOULD BE USED.

G. Where 30% modulation at 400~ is called out in preceding paragraphs, see paragraph VI-B 1 through 5 for method of setting H-14 Signal Generator.

TEST PROCEDURE
for
AIRCRAFT RADIO CORPORATION RECEIVER
TYPE R-13B

VI. INTRODUCTION

Each receiver is tested as a unit. The requirements of interchangeability of units in a system make this procedure necessary. "Average" figures characterizing the performance of the receivers are given in the attached table. These "average" figures are selected to approximate original theoretical design. B-10A Converter should not be installed during receiver tests unless specified.

A. PROCEDURE

1. Before the following tests are made on a Receiver, it must have been completely aligned; and just preceding these tests it should be warmed up at rated input voltage for ten minutes. The following conditions, unless otherwise specified, are used throughout the test:

(a) Input voltage: 13.5v DC or 27v DC, as required.

(b) Telephone output load: 300 ohms pure resistance; (see IV A1b) (paralleling telephones must not affect value of any output measurement).

(c) Signal source: Unless otherwise specified, to antenna receptacle, connect H-14 attenuator output through RG-58/U cable supplied with H-14 Signal Generator; to mixer grid IF, 5-ohm signal generator output to mixer grid test jack.

(d) Modulation: 30% at 400 cps. This is obtained by feeding the output of the Hewlett-Packard Audio Oscillator into the EXT MOD posts on the H-14 Signal Generator.

B. THEN

1. Set up H-14 as per paragraph IV-B through step 9.

2. Be sure both the 30~ MOD control and the 9960~ MOD control are turned as far counterclockwise as possible (zero output).

3. Set function switch at "9960~ MOD — Set."

4. Adjust output level from audio oscillator to provide red line reading on MOD meter.

5. The above procedure provides 30% modulation of the RF output of the H-14 Signal Generator. If the function switch is turned to the RF position, the reading of the MOD meter will be less than red line indication. This is due to the fact that the MOD meter reads approximately 100% modulation when the function switch is in the "RF — Set" position.

6. Audio fidelity reference frequency: 400 cps.

7. RF sensitivity control: at maximum sensitivity (See IV A1c).

8. Audio level: Set for maximum audio level.

C. Throughout the test procedure the terms "high dial," "mid dial," and "low dial" will be used. These refer to frequencies which will be found in the attached Table. The first column of this Table serves to identify the test with the information given below under corresponding numerical headings. All measurements determined in accordance with the following directions are referred to the test limit requirements given in Table I.
Set dial on C-22A Control Unit in accordance with procedure set forth in Type 15C Instruction Book.

D. 1. *Meters*: Read meters in test panel under the following conditions: signal input, 0; sensitivity control, maximum. Measure HV at H.V. test point on Receiver Test Harness (IV A1i).

2. *"High Dial" (H) Sensitivity*: (Test No. 2) Sensitivity is defined as the signal input expressed in microvolts, with receiver tuned to resonance, required to produce an output of 10 milliwatts. (1.73 Volts across 300 ohms).

(a) Check receiver tuning against H-14 Signal Generator frequency at exact "high dial" (H) frequency, with modulation on, and at a low output (insufficient to operate AVC). If receiver dial calibration is not within 50 kc at this point the receiver must be realigned in accordance with ARC "Alignment Procedure."

(b) Tune receiver to exact "high-dial" frequency supplied from H-14, using low output (insufficient to operate AVC). Adjust H-14 Signal Generator output until receiver output is 1.73 volts (10 milliwatts into 300-ohm load) and measure sensitivity.

3. *IF Sensitivity at Mixer Grid*: (Test No. 3) Connect 15 Mc Signal Generator through test probe to mixer grid test jack and measure mixer grid IF sensitivity, by tuning 15 Mc Signal Generator to resonance with IF amplifier, using low output (insufficient to operate AVC). Test probe must make ground connection to preselector adjacent to test jack.

4. *Sensitivity Control*: (Test No. 4) Increase H-14 Signal Generator output to 10,000 uv, increase resistance of sensitivity control, and measure ohms required for 10 milliwatts output. This control is the one on Receiver Test Harness.

5. *Instability*: Remove modulation, increase H-14 Signal Generator output to 1.0 volt and test receiver for instability by tuning the frequency control and simultaneously exploring the sensitivity control range. Instability will be evidenced by motorboating, substantially constant pitch tones, or other unnatural noises, excluding "tweets."

6. *AVC Knee Output*: (Test No. 5) Keeping receiver tuned to resonance, increase H-14 Signal Generator output until cathode current is reduced by 1 milliampere. Measure receiver output. (See IV A1d).

7. *AVC*: (Test No. 6) Set H-14 Signal Generator to 10,000 uv output. Measure receiver output on output meter. (See IV A1b).

8. *Overload*: (Test No. 7) Increase H-14 Signal Generator output to 1.0 volt. Measure receiver output on output meter.

9. *Noise*: *a. Radio; b. Audio*: (Test No. 8)

(a) Adjust H-14 Signal Generator output to produce 10 milliwatts at resonance; switch off modulation. Measure receiver output at maximum sensitivity.

(b) Increase resistance of sensitivity control to 50,000 ohms and measure receiver output.

10. *"Mid Dial" (M) Calibration*: (Test No. 9) Adjust H-14 Signal Generator to "Mid Dial" (M) frequency and tune receiver accurately to resonance. Keep the receiver output below 2 volts by appropriate adjustment of signal generator output level. The difference between the frequency indicated by the dial and the signal generator frequency is the calibration error.

Note: The sense of the calibration error is positive (+) if the receiver's indicated frequency is higher than the actual input frequency to which the receiver is resonant.

11. *"Mid Dial" (M) Sensitivity*: (Test No. 10) Measure sensitivity as in Test No. 2 except at (M).

12. *"Low Dial" (L) Calibration*: (Test No. 11) Measure calibration error as in Test No. 9 except at (L).

13. *"Low Dial" (L) Sensitivity*: (Test No. 12) Measure sensitivity as in Test No. 2 except at (L).

Note: "Mid Dial" (M) tests (optional); used only for determination of calibration accuracy and sensitivity at middle of tuning range.

14. *Tuning Meter*: (Test No. 13) Set H-14 Signal Generator to 100 microvolts output, (30% 400~ modulation) tune receiver to resonance, and record tuning meter current.

15. *Audio Fidelity*: (Test No. 14) Set H-14 Signal Generator to 50 microvolts output 400~, 30% modulation. Keeping receiver tuned to resonance, adjust sensitivity control to give 2 volts output. Use this receiver output as reference. Change modulation frequency to 100 cps and to 5000 cps and measure the 100 cps and the 5000 cps fidelity. Fidelity is defined as the ratio of output voltage at any modulation frequency to output voltage at the reference modulation frequency, expressed in percent.

16. *Navigation Output*: (Test No. 15) Set H-14 Signal Generator to 100 microvolts output and tune receiver to resonance. Using 30% (adjust as previously outlined) modulation in each case, set modulation frequency to 30, 90, 150 and 10,000 cps and measure NAV-MOD output at each frequency.

17. *Receiver Phase Shift at Reference Input*:

(a) Apply omni modulation from H-14 Signal Generator. Connect H-14 attenuator output to receiver antenna terminal. Set H-14 Signal Generator attenuator output to 100 microvolts reference.

(b) With Receiver and B-10A Converter connected through test harness to the Rack, adjust L.V. to 13.5/27v and adjust Course Selector for vertical pointer center.

(c) Course Selector reading should correspond to "Track Angle" being generated by the H-14 Signal Generator.

(d) Assuming that the Converter has been properly adjusted, any discrepancy noted in (c) above may be due to an improper amount of phase shift in the receiver. The receiver alone should have an indicated 191° phase shift when tested by the H-14 Signal Generator, i.e. when DEMOD output of 0° track angle is fed to converter alone, the Course Selector should indicate 191° TO when the Cross Pointer Meter is centered. Improper phase shift in the Receiver seldom occurs, but may be corrected by adjustment of R-141 in the receiver (see Note 8 on Schematic). A thorough check of the converter should be made before attempting any changes in this component.

18. *Input at which Oscillator Starts*: (Test No. 16) Reduce supply voltage only enough to stop oscillator. Wait 10 seconds, then gradually increase supply voltage; note voltage at which oscillator starts, and restore to nominal supply voltage.

TABLE I

AIRCRAFT RADIO CORPORATION RECEIVER

TYPE R-13B

Test Conditions, Test Limits & Production Averages

DC Supply Voltage (v)	14/28
Frequency Band (Mc)	108-135
Intermediate Frequency (Mc)	15
"High Dial" (H) Frequency (Mc)	131
"Mid Dial" (M) Frequency (Mc)	121
"Low Dial" (L) Frequency (Mc)	111
Image Frequency at H (Mc)	101

Test No.	Name of Test			Note	Dial	Test Limits	Average
1	Meters — A. Input Current	(14v)	a	a	H	3.8-4.2	4.0
		(28v)	a			2.0-2.5	2.2
	Meters — B. Plate Voltage (Receiver Load Only)	(14v)	v	a	H	230-260	240
		(28v)	v			235-270	250
	Meters — C. Cathode Current	(14v)	ma	a	H	12-16	14.0
		(28v)	ma			12-17	14.5
2	Sensitivity		uv	a	H	<3.0	1.25
3	IF Sensitivity at Mixer Grid		uv	a	H	100-300	230
4	Sensitivity Control (0-50,000)		ohms	a	H	12K-25K	17.5K
5	AVC Knee Output		v	a	H	5.0-8.5	6.0
6	AVC (10,000 uv input)		v	a	H	8.5-11.5	10.2
7	Overload (1.0v input)		v	a	H	Note d.	11.2
8	Noise — A. Radio		v	a	H	<1.2	1.1
	Noise — B. Audio		v			<.04	.016
9	Calibration (optional)		±kc	a	M	<150	±71
10	Sensitivity (optional)		uv	a	M	<3.2	1.35
11	Calibration		±kc	a	L	<80	±21
12	Sensitivity		uv	a	L	<3.0	1.35
13	Tuning Meter (if used)		ma	a	L	.53-.80	.65
14	Audio Fidelity — A. 100 cps		%	b	L	15-25	20
	Audio Fidelity — B. 5000 cps		%			40-50	46
15	Navigation Output — A. 30 cps		v	a, c, f	L	1.6-2.8	2.0
	Navigation Output — B. 90 cps		v			1.6-2.8	2.0
	Navigation Output — C. 150 cps		v			1.6-2.8	2.0
	Navigation Output — D. 10,000 cps		v			1.6-2.8	2.0
16	Oscillator Starts at	(14v)	v	a, e	L	<9.5	8.75
		(28v)	v			<19.0	18.1

Notes: a. Max. sensitivity.
b. 50 uv in, 2 v out.
c. 100 uv in.
d. Not less than value obtained in Test 6.
e. 500 uv in.
f. Loaded by V.T.V.M. only.

TEST PROCEDURE for

AIRCRAFT RADIO CORPORATION CONVERTER TYPE B-10A

VII. INTRODUCTION

Because of the requirement of interchangeability of units in a Type 15C omni system, each Converter is tested and adjusted as a unit. "Production average" figures and "test limit" figures characterizing the performance of the Converters are given in the attached table.

The following adjustments are based upon operation of 3 Cross Pointer Meters and 3 Flag Alarms. E-13B Racks are supplied with dummy loads for 2 Cross Pointer Meters and 2 Flags. Be sure the load on the Converter is equivalent to 3 instruments for all tests.

A. PROCEDURE

1. With power off, connect the Receiver with a D-10A Dynamotor of proper voltage through its Test Harness to the Rack. During B-10A adjustment and tests this Receiver serves only as HV power supply and filter. Connect B-10A Converter to E-13B Rack through Test Harness #15859. Connect F-10A Filter Amplifier, since F-10A and B-10A outputs are paralleled to the Cross Pointer Meter.

2. Throw switch on receiver test harness to connect DEMOD output of H-14 to E-13B Rack. This disconnects audio output from the Receiver.

3. Set function switch on C-22A Control Unit to OMNI.

4. (a) Using coax cable supplied, connect DEMOD jack on H-14 to the Navigation Audio input jack on Receiver Test Harness (See IV A1f).
(b) Turn on H-14 Signal Generator and throw STANDBY-OPERATE switch to OPERATE. Set up H-14 as outlined in paragraph IV-B.

5. Adjust omni test voltages as follows:
(a) Connect VT Voltmeter between NAV-MOD test jack on Receiver Test Harness and ground (See IV A1g).
(b) Set function switch of H-14 at "30∼ MOD-SET" and adjust 30∼ MOD control for red line indication on MOD meter. Then adjust DEMOD output of H-14 to produce a reading of 1.6 volts on VT Voltmeter. Converter must be connected to rack and converter load connected when making this adjustment. (Note a, Table II)

6. Turn R-206 to the extreme counterclockwise position, R-212 and R-225 to their approximate mid positions.

7. (Test No. 1) Turn on LV; adjust LV until HV (read at H.V. Jack on Converter Test Harness) is 240 volts. Read LV and HV input currents to converter.

8. (Test No. 7B) With the function switch at "30∼ MOD-SET" on the H-14, read the variable channel output voltage with the VT Voltmeter connected between test jacks J-204 and J-205. This voltage should be 3 to 5 volts or it is indicative of trouble.

9. Adjust R-225 to obtain an "on course" indication on the Cross Pointer Meter (i.e. zero current).

10. Set function switch on H-14 to "9960∼ MOD-SET" and adjust to produce a reading of 1.6 volts on the VT Voltmeter connected between AF input test jack on Receiver Test Harness and ground. (Note a, Table II) (See IV A1g)

11. Turn function switch on H-14 to OMNI and track angle 0° TO.

12. (Test No. 7A) Set Course Selector to 191°.

13. Adjust R-206 to obtain approximately 3.8 volts at the reference channel output with the VT Voltmeter at test jacks J-203 and J-204.

14. With the H-14 track angle set at 0° TO, adjust R-212 for "on course."

15. Set omni track angle on H-14 to 180° and adjust R-225 to reduce the off course indication by 2:1.

16. Repeat steps 14 and 15 until "on course" is obtained for both 0° and 180° track angles.

17. (Test No. 4) Set H-14 track angle to 0° and set Course Selector to 181°. Adjust R-206 to obtain a cross pointer meter reading of 150 microamperes to the right, or 5 dot deflection of the ID-48 Cross Pointer Meter on the *YELLOW* side.

18. (Test No. 2A) Reset Course Selector to 191° and again read the reference channel output (between J-203 and J-204). If it is not equal to the variable channel output (between J-204 and J-205) within ±.7v, change R-236 to a value which will produce the required balance of these outputs. See Test Limits. (An increase of 2K in this resistor value gives an increase in variable channel output of approximately 0.3 volts.) As the variable channel output is raised, the reference channel output must be decreased, and vice versa, to maintain the proper off course deflection for the above settings of the H-14 and the Course Selector.

19. (Test No. 7C and D) With the VT Voltmeter read the output of V-201A between pin 1 and ground, and the input of V-201B between the arm of R-206 and ground.

20. (Test No. 2B and 3) Set omni track angle on H-14 to 0° TO. Set Course Selector to 191°. TO-FROM Meter

should show TO. If Cross Pointer Meter is not centered, adjust R-212 for "on course." Check as above for track angles in steps of 30° around the compass. The Course Selector should lead the H-14 track angle by 191° for center indication of the Cross Pointer Meter. Errors may be corrected by changing R-233 as required to produce this result. For each .5 degree deflection to the right occurring on tracks in the vicinity of 30° or 210° as shown by the H-14 track switch, reduce R-233 by 5K. Correspondingly if meter movement is to left, increase R-233. After changing R-233 readjust R-212 for "on course" indication at 0°/191° settings, or as required to give minimum error. *Caution*: Do not change R-233 unless it is damaged or R-234 or C-213 have been changed. Errors are most apt to be caused by other trouble.

21. (Test No. 4) Adjust R-206 slightly, if necessary, to produce a course width of 20°. This is determined by rotating the Course Selector to produce a 5 dot to 5 dot swing of the Cross Pointer Meter for any track angle supplied by the H-14. If a 1000-ohm 150-0-150 Microammeter is used, full scale deflection is equivalent to 5 dots.

22. (Test No. 5 and No. 6) Record Flag current and TO-FROM meter current (both TO and FROM) when "on course."

23. Lock R-206, R-212 and R-225 and adjustment is complete.

TABLE II

AIRCRAFT RADIO CORPORATION CONVERTER

TYPE B-10A

Test Conditions, Test Limits & Production Averages

Test No.	Name of Test				Note	Test Limits	Average
1 DC Input	A. LV Input Current	(14v)	a		f	.6-.65	.62
		(28v)	a			.30-.34	.32
	B. HV Input Current		ma		f	12-18	14.9
2 Resistor Values	A. Variable Channel Gain (R-236)		ohms		a	11K-27K	17K
	B. Phase Splitting (R-233)		ohms		a	0-20K	13K
3	Max. Course Error		(±) *degrees*		a	.7	.3
4	Course Sensitivity		degrees		abc	19-21	20
5 Omni Performance	Flag Current		ma		a	.3-.5	.36
6	To-From Meter	A. TO Current	ua		a	75-110	85
		B. FROM Current	ua		a	75-110	85
7 Voltage Readings	A. Ref. Output (J-203 to J-204)	30 ~	v		ad	3.0-4.4	3.6
	B. Var. Output (J-205 to J-204)	30 ~	v		ad	3.0-5.0	4.0
	C. V-201A Output	9960 ~	v		ad	11-20	15.3
	D. V-201B Input	9960 ~	v		ad	.7-1.3	.94

Notes: a. Std. omni modulation input, 30 ~ and 9960 ~ = 1.6 ±0.1v each.
b. Measured by "five-dot" limits on Cross Pointer Meter, i.e. ±150 ua.
c. Measured on standard Course Selector.
d. Measured with Ballantine Model 300 Voltmeter.
e. Measured with LV = 13.5 or 27 and HV = 240.

TEST PROCEDURE

for

AIRCRAFT RADIO CORPORATION FILTER AMPLIFIER

TYPE F-10A

VIII. INTRODUCTION

Because of the requirement of interchangeability in a system, each Filter Amplifier is tested as a unit. The attached Table III gives production averages and test limits.

A. DEFINITION OF TERMS

1. *Amplitude Localizer (AMP LOC) Modulation*
Amplitude localizer modulation consists of the sum of a 90∼ wave and a 150∼ wave.

2. *Standard Amplitude Localizer (AMP LOC) Modulation*

CAA Amplitude Localizer facilities are theoretically adjusted to produce an amplitude localizer modulated RF signal having the following components:

(a) On course, Cross Pointer Meter center
90∼ modulation = 20%
150∼ modulation = 20%

(b) Off course, Cross Pointer Meter left (for approximately 2 degrees off course)*
90∼ modulation = 15.9% (2 db down from 20%)
150∼ modulation = 25.2% (2 db up from 20%)

(c) Off course, Cross Pointer Meter right (for approximately 2 degrees off course)*
90∼ modulation = 25.2% (2 db up from 20%)
150∼ modulation = 15.9% (2 db down from 20%)

*The actual number of degrees off course for this condition of modulation is to be established by the CAA.

B. PROCEDURE

1. With power off, connect the F-10A to the E-13B Rack. Install Receiver R-13B with Dynamotor D-10A in its test harness and B-10A Converter in Rack. All equipment must be of same voltage. Throw function switch on C-22A to VAR-LOC.

2. (Test No. 1 and No. 2) Turn on LV; adjust LV until HV is 240v. Read LV and HV input currents to F-10A.

3. Connect the DEMOD output of the H-14 Signal Generator to the test receptacle on the Test Harness. Set up H-14 as in IV-B and throw function switch to AMP LOC "needle *center*." Adjust DEMOD output control until the VT Voltmeter connected to NAV-MOD test point on receiver test harness reads 1.7 volts.

4. (Test No. 3) Under the conditions of step 3, turn the SENS potentiometer R-403 to approximately its mid position and then adjust the BAL potentiometer R-408 to obtain an "on course" indication on the Cross Pointer Meter.

5. Set the function switch on H-14 to "AMP-LOC" "needle *left*" position.

6. (Test No. 4) Under the conditions of step 5, adjust the SENS potentiometer to obtain a Cross Pointer Meter reading of 90 ua to the left (or to the edge of the blue segment of the ID-48 Cross Pointer Meter).

7. Set the function switch of the H-14 to "AMP-LOC" "needle *right*" position.

8. (Test No. 5) Under the conditions of step 7, the Cross Pointer Meter should read approximately 90 ua to the right (or to the edge of the yellow segment of the ID-48 Cross Pointer Meter). If the reading departs from 90 ua by more than 5 ua, readjust the SENS potentiometer to reduce the departure by 2:1.

9. Recheck steps 4, 6 and 8 and record the meter readings. As a matter of information, one needle width is approximately equal to 5 ua.

10. (Test No. 6) Record Flag current under conditions of step 4.

11. Lock Balance and Sensitivity potentiometers.

TABLE III

AIRCRAFT RADIO CORPORATION FILTER AMPLIFIER

TYPE F-10A

Test Conditions, Test Limits & Production Averages

Test No.	Name of Test				Test Limits	Average
1	LV Heater Current	(14v)	ma	LV = 13.0	145-169	157
		(28v)	ma	LV = 26.5		
2	HV Current		ma	HV = 240	7-13	10
3	Balance, on course		ua		±5	0
4	Sensitivity, off course left		ua		81-99	90
5	Sensitivity, off course right		ua		81-99	90
6	Flag Current, on course		ma		.3-.45	.38

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